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Journal

OF THE

Royal Army Medical Corps

EDITED BY

COLONEL W. H. HORROCKS, C.B., K.H.S.

ASSISTED BY

LIEUT.-COLONEL D. HARVEY, C.M.G., R.A.M.C.

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Journal

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Royal Army Medical Corps.

Original Communications.

THE DIAGNOSIS AND TREATMENT OF MALARIAL FEVER.

With Illustrating Charts.

BY CAPTAIN DAVID THOMSON.
Royal Army Medical Corps.

(*Continued from p.* 685, *vol. xxviii.*)

(8) THE NECESSARY AND MINIMUM SHORT QUININE TREATMENT REQUIRED TO OBTAIN A REASONABLE GUARANTEE OF A CURE IN RECENT CASES.

It can be stated as a fact, that a routine treatment which will cure many cases, will not cure all. No definite and infallible cure for all cases is yet known. Subjects in a bad state of health, as already mentioned, and patients in whom the malaria is complicated with other diseases, especially syphilis, are more difficult to cure. Also long standing cases who have received small doses of quinine, or who have received the drug intermittently, may become exceedingly resistant. It is also believed by many observers that malaria in certain parts of the world is more resistant to treatment than the malaria which occurs in other localities. This is quite probable, for if we take sleeping sickness as an analogy, we find that the Rhodesian type is much more resistant to atoxyl than the West African type or even the Uganda type. There are undoubtedly certain fortunate individuals who are cured of their malaria by a few small doses of quinine, yet from the careful investigation of our 200 cases, in such a way as depicted on Charts

4 to 12, we were forced to conclude that nothing less than a continuous course of quinine of thirty grains daily given in solution by mouth every day for three weeks could be considered as a curative treatment. In all of our cases treated in this manner except one, the temperature fell as a rule to normal on the second or third day of treatment and remained normal. No asexual parasites could be found in thin films in the peripheral blood after three days, and I have never found asexual parasites in even thick films after five days of such treatment. We tried to keep in touch with the patients who had received this three weeks' course of treatment after they left hospital. This was very difficult, but in no case did we ever hear of a relapse. They were apparently cured. We had one exception, which will be described in detail under paragraph 15. Taking into account, therefore, the fact that we lost touch with many of the patients after they left hospital, I am inclined to believe until it can be proved otherwise that this three weeks' continuous treatment will permanently cure eighty per cent of all early cases.[1] By allowing for twenty per cent of relapses I may be erring on the safe side, since out of our 200 cases I know of none which relapsed, except the resistant case to which I have already referred. So far as I know, therefore, only ½ per cent relapsed after this treatment. Rightly or wrongly, I have added on an extra 19½ per cent because the majority of our cases were lost trace of after their departure from hospital. This however was a good sign, for had these cases relapsed it is likely that they would have returned again to hospital sooner or later. None of them returned, except some of those who insisted on leaving before they had received their three weeks' course. These were warned that a relapse was likely to happen. Our warning on several occasions proved correct and they had to be readmitted for further treatment. The experience of the physicians in Panama coincides exactly with what I have just said. The routine treatment which they adopted after some years of experience was the oral administration of thirty grains of quinine daily in solution for a period of three weeks. Later they raised the amount to forty-five grains daily for a similar period, since it was found that fewer relapses occurred with this increased dosage. They considered that such a treatment was curative in the great majority of cases. The American patients usually remained in hospital long enough to

[1] The majority of our cases were fairly recent, and had not received much previous quinine.

receive this course, because they continued to receive their pay during their illness. On the other hand the Spanish and other unskilled labourers did not receive pay when not working. In consequence, practically all of them insisted on leaving hospital after a week, by which time their fever had disappeared and they were feeling quite well. Amongst this class relapses were frequent. Amongst the Americans they were extremely rare. These results are all the more valuable because towards the completion of the Panama Canal, the zone had become so thoroughly and completely sanitated that primary infections of malaria from mosquito bites had almost ceased to exist. The readmissions to hospitals, therefore, could be considered more or less confidently as relapse cases.

(9) The Quinine Treatment of Malaria Cases exhibiting Pernicious Symptoms such as Coma and Persistent Vomiting.

It will be observed that in Panama as well as at the Liverpool Tropical School, quinine was administered in solution by the mouth as a routine treatment. In comatose cases and in cases with persistent vomiting this mode of administration is, however, out of the question. In such circumstances it is necessary to inject the drug intravenously, intramuscularly, hypodermically or rectally. In these dangerous pernicious cases it is also necessary to increase the dose of quinine to the highest maximum in order to fell the disease as quickly as possible. Comatose symptoms are especially very grave, and if considerable doses of quinine are not given at once the patients are likely to die. The prognosis in comatose cases depends almost entirely on the duration of the coma before treatment is commenced, thus if the patient comes under the care of a physician immediately after the onset of the coma and is vigorously treated at once, the chances of recovery are very good. On the other hand the longer the coma has existed before the treatment is commenced the greater will be the number of deaths. In Liverpool, all of our cases recovered except those which were admitted to hospital in a moribund condition and who had no doubt been comatose for twenty-four hours or longer. It should be remembered that as a rule comatose symptoms would never arise if every case of malaria was treated early and thoroughly. In Liverpool we carried out the following mode of treatment. The patient is kept warm by several hot-water bottles well covered with flannel to prevent them from burning the skin. In this way it was attempted to bring on perspiration. Perspiration relieves the

symptoms considerably and in all cases of malaria it is important to keep the skin moist and acting. With regard to quinine we injected rectally about forty grains of the bihydrochlorate or bi-hydrochloride (the most soluble salts) in about four ounces of warm water. We also injected intramuscularly at the same time thirty grains of the bihydrochlorate and massaged it well in.[1] This was repeated if necessary after twelve hours. On several occasions we obtained very good results with hypodermic injections of quinoforme (Lacroix). This is a soluble basic formate of quinine—a French preparation. It should be injected deeply under the skin in two or three different places and thoroughly massaged into the subcutaneous tissues. In Panama, Dr. W. M. James obtained very good results with intravenous injections. He dissolved the bihydrochloride in normal saline (22·5 grains to 200 cubic centimetres). This was sterilized by boiling and after allowing to cool to blood heat it was run into a vein as in the injection of "606." In this way the necessary amount of quinine was administered and at the same time it was considered that the quantity of salt solution acted as a transfusion and diluted the toxins of the disease. If necessary this intravenous injection was repeated in eight to twelve hours. About twenty-four hours after the administration of these massive injections of quinine, it will be found that the parasites have become more or less scarce, yet the patient may die on account of the damage already done to the system by the parasites and their toxins before the treatment was commenced. In cases which recover it will usually be found that the coma passes off within twenty-four hours after the massive dose of quinine. As soon as the coma disappears quinine can be given by the mouth in solution in the usual way in doses of thirty to forty-five grains daily for three weeks. In cases of malaria with persistent vomiting it is also necessary to inject quinine. These cases are not nearly so dangerous as comatose cases. As a general rule, it will be found that the vomiting will cease within twenty-four hours after the injection of thirty grains of quinine. Even in the very worst cases it is not likely to last more than two days. After the vomiting has ceased for twenty-four hours it will be found that the quinine can be given in solution by the mouth in the usual way. All other pernicious cases can be treated successfully by

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[1] Dissolve the thirty grains in about forty minims of distilled water and sterilize by boiling for a few minutes. Not more than fifteen grains should be injected into one spot.

administering orally thirty grains in solution daily, but larger doses may be given according to the severity and urgency of the symptoms. In cases with hyperpyrexia it may be necessary to reduce the temperature by tepid sponging of the whole body and by the administration of such drugs as phenacetin or aspirin. The quinine alone, however, will reduce the temperature very markedly within twenty-four hours. It is important in malaria, as it is in nearly all other diseases, to clear out the bowels thoroughly by administering three to five grains of calomel followed by salts several hours later. In comatose cases where oral administration is difficult, some experienced authorities strongly recommend croton oil for this purpose. One to two drops mixed in butter are placed on the tongue. A waterproof sheet should be placed under the patient as the fæces will be passed involuntarily. In such cases also it is very important to attend to the bladder, as the urine may require to be drawn off with a catheter while the coma lasts.

(10) The Nature and Cause of the Pernicious Symptoms.

The malignant tertian parasite in the vast majority of cases of malaria is the cause of the pernicious symptoms. These symptoms are comparatively rare in cases of benign tertian and quartan. I have already stated that the asexual parasites in malignant tertian malaria reach maturity and sporulate in the fine capillary blood-vessels in the inner organs. In consequence it is very difficult to find these mature forms in peripheral blood films. It was generally supposed that this sporulation of the parasites within the capillaries of the brain and other organs gave rise to symptoms such as coma, hemiplegia, pernicious vomiting, etc. On post-mortem examination of comatose cases it is found that the brain capillaries are blocked with masses of sporulating parasites and that small petechial hæmorrhages have also occurred. As a result of these minute hæmorrhages the meninges often present a rusty appearance. The spleen, liver and bone marrow, etc., are also found to be full of sporulating parasites and masses of black pigment. Dr. W. M. James has found sporulating forms in the capillaries of the placenta. The reason why malignant tertian parasites always sporulate in the inner organs with consequent tendency to pernicious symptoms was more or less a mystery until at last it was explained in a very wonderful manner in the culture tube. Two American workers, Bass and Johns (1912), were able to cultivate the parasites of malarial fever successfully for the first

time. Later Thomson, J. G. and McLellan, S. W. (1912) and Thomson, J. G. and Thomson, D. (1913) discovered that in the culture tubes, the red blood cells containing half-grown and sporulating forms of the asexual malignant tertian parasites tended to clump together into masses, as shown clearly in the photomicrographs, Plate I. A very remarkable case of malignant tertian malaria described by Cropper, J. (1908), also showed this clumping of the red cells containing half-grown parasites in a film of the peripheral blood of a patient (*vide* Plate I). On the other hand, clumping of the red cells containing parasites was never observed in the culture tube during the growth of the benign tertian malarial parasites. These culture experiments therefore give a clear explanation of the cause of the pernicious symptoms in the former and of their absence in the latter. They also explain why the parasites in malignant tertian malaria sporulate in the fine capillaries of the inner organs, and the reason why only the young ring forms circulate in the peripheral blood. As soon as the malignant tertian parasite has grown larger than the young ring stage, its containing corpuscle evidently becomes sticky, so that all such red corpuscles containing parasites, no longer very young agglutinate together into masses. These masses, acting like small emboli, are caught in the fine capillaries of the inner organs and cease to circulate. There can be little doubt that this embolic tendency is the cause of the petechial hæmorrhages in the inner organs and the cause of the pernicious symptoms. On the other hand it is the absence of this agglutination phenomenon with consequent absence of emboli in the case of benign tertian malaria which renders this type of the disease comparatively free from pernicious symptoms.

(11) The Best Mode of giving Quinine as a General Curative Routine Treatment.

(*a*) *Amount of Quinine, Time and Mode of Administration.*—The amount of quinine that should be given in malaria and the mode of administration has always been a vexed question, chiefly because cases vary with regard to results. Some authorities state that the time of administration is very important. They say that the young spore forms of the parasite just newly liberated from the sporulating schizonts are the most vulnerable to quinine, and this view is probably correct.[1] Theoretically, therefore, quinine in order

[1] Others hold the opposite view.

to be most potent should be given in one large dose an hour or two before the sporulation or paroxysm is due. I have no doubt that this would give very satisfactory results, but I do not believe it is of very great importance. I have observed that quinine can destroy the asexual parasites in all its stages. In any case this treatment as a routine would be difficult since we do not always know when the paroxysm is due and the parasites do not all sporulate as a rule at the same time. The results are always most satisfactory if a given amount of quinine is given daily, no matter at what time, and I think the amount of quinine given is more important than the time at which it is given. Again some advocate that the quinine, say thirty grains daily, should be given in small doses every two hours. I think that this would be more or less a waste of time as well as a severe strain on the memory of the nurse in charge.[1] Perhaps the most common sense method is to give the quinine as a routine, in doses of ten to fifteen grains three times daily in solution by the mouth. This spreads the dosage sufficiently to prevent the maximum quininism effect that would be produced by giving the thirty to forty-five grains at one time. It also ensures that there will be a considerable quantity of quinine in the circulation throughout the twenty-four hours, constantly injuring the parasite in all its stages.

(*b*) *The Respective Values of the Different Quinine Salts.*—All quinine salts seem to be equally potent provided they get absorbed into the circulation. It is, however, reasonable, in order to ensure this, that one should give the most soluble salts. The bihydrochlorate and the bihydrochloride are the most soluble of all. The hydrochloride and hydrobromide salts are also very good. The sulphate and the tannate are much less soluble. As a general rule any salt of quinine given even in powder or tabloid form is absorbed into the system. But in some cases I believe it has been proved that the tabloids have been found in the fæces. Anyhow, to make sure of absorption, it is best to give a soluble form of the drug in solution; for, although the average patient will absorb it in any form, there are others in whom the absorptive power of the mucous membrane is weak, due to malarial gastritis and other causes. It is well to remember that the sulphate requires a considerable

[1] This small dose method has been given a trial by Major McCarrison, I.M.S., at the malaria investigation department, No. 4 London General Hospital. He has found it useful in cases of gastritis, where the drug is not well tolerated by the stomach. In such cases he gives the drug in small doses well diluted.

amount of acid to dissolve it; in consequence, too much acid is given when large doses of this salt are administered. It has been stated that the acid sulphate is the cause of blackwater fever, but I have seen this disease follow the administration of the hydrobromide. It is considered that the hydrobromide salt produces less quininism than the others, on account of the sedative influence of the bromide radicle. The value of euquinine and the tannate salt lies in the fact that they are more or less tasteless when given in powder or tabloid form.

(c) *The Hypodermic and Intramuscular Injection Controversy.*—There is a more or less scattered school of injectionists who believe that quinine is much more potent if injected hypodermically or intramuscularly than it is when given by the mouth. They at first stated that it was absorbed more quickly and certainly when injected, but it was demonstrated by Buchanan (1903) that quinine when injected was not absorbed so quickly as when given by the mouth. This was proved by urine analysis, and also by cutting down over the site of injection, when it was found that the quinine tended to crystallize out and remain unabsorbed for a considerable time. After this the injectionists stated that the therapeutic effects obtained by injection were superior, because the quinine was absorbed slowly, and hence a more prolonged action of the drug was obtained. Others went so far as to maintain that cases, in which little or no effect was produced by large doses given orally, were cured quickly with about three injections of five to ten grains of the drug. Although as a general rule quinine injections are no more potent than when the quinine is given orally, yet there seems now to be some evidence that the former mode of administration may succeed in certain cases of malaria when the oral method fails. Stott (1916) records several such cases, and this is the experience also of several other clinicians in India and Africa. Bignami (1894), on the other hand, records a case in which after a gramme (15·4 grains) of quinine had been given by hypodermic injection daily for a month a relapse, with the finding of parasites in the blood, followed almost immediately. It is highly probable that coincidence or chance plays a large part in these apparent discrepancies. Even persistent relapsing cases of malaria will get well some time or other, and if a few small injections happen to be given at that time, the end of the disease is attributed to them. The oral administration in our experience has been so uniformly successful that we by no means advocate the routine use of injections. We must admit, however, that apart from cases with coma

and persistent vomiting the injectionist school has a right to claim further consideration, so that all cases which appear to resist the routine quinine treatment by the mouth, or which relapse after this treatment, should receive the drug by intramuscular or hypodermic injection as well. In view of the evidence now accumulated, perhaps the most sensible routine treatment would be to give part of the quinine orally, and part by injection with arsenic in addition. The hypodermic injectionists in ordinary cases do not, as a rule, administer more than ten grains daily. Hence a good compromise would be to give as a routine treatment thirty grains daily for three weeks by the mouth, as we have recommended, and, in addition, ten grains daily by injection during, say, the first five and the last five days of this treatment. With such a treatment I have no doubt that the great majority of early cases would be permanently cured.

I do not know, however, of any advocate of the injection method who has proved his point by careful and prolonged scientific experiment; the few cases which they described may be mere coincidences as already stated. At present some careful researches are being carried out under Sir Ronald Ross with regard to the best modes of quinine administration, and, so far, the hypodermic and intramuscular injection methods have not proved in any way superior to the method of oral administration. If this is so, then it cannot be considered as a good routine method of giving quinine, because it is troublesome. It necessitates the sterilization of the syringe and the solution each time, and it is also painful to the patient. It seems to me, therefore, that as a general routine treatment in ordinary straightforward early cases the oral administration is best, and that injection into the tissues should only be employed as already stated in cases suffering from coma and persistent vomiting when oral administration is out of the question. One must also bear in mind, however, that rarely, due to gastritis or other causes, quinine is not absorbed well from the alimentary tract. In such rare cases of course administration by injection is indicated.

(*d*) *The Value of Intravenous Injections.*—The intravenous injection of quinine is a comparatively recent mode of treatment, and the results obtained, so far, seem to give considerable promise of success. James (1913), as already stated under paragraph (7), found that the "residuum" of parasites in the spleen and marrow was apparently destroyed more quickly by intravenous injection than by oral or hypodermic administration. Dr. Molloy's case, which was eventually cured by an intravenous course of the drug, after a

other modes of administration had failed, would also appear to point to its value. In this case the bihydrochloride of quinine and urea was used, each dose being dissolved in 200 cubic centimetres of normal saline, and run into a vein by means of a "606" injection apparatus. I have tabulated this routine course as follows:—

INTRAVENOUS COURSE—EACH DOSE OF QUININE DISSOLVED IN 200 CUBIC CENTIMETRES NORMAL SALINE.

Days ..	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Grains quinine	20	20	20	..	30	..	30	..	30	..	30	..	..	30	..	..	30	..	..	..	..

This intravenous course would, no doubt, be still more efficacious if thirty grains of the drug were administered orally in addition on the fourth, sixth, eighth, tenth, twelfth, thirteenth, fifteenth, sixteenth, eighteenth, nineteenth, twentieth, and twenty-first days, that is to say, on the days when no quinine is given intravenously and thereafter until the end of the third week. In view of James's statements, and pending further researches on this subject, I would advise that such a course of treatment should be employed in all resistant cases which have relapsed in spite of a thorough routine course of the drug by oral or hypodermic administration. Quinine has also been given intravenously by injecting more or less concentrated solutions (about twenty grains in twenty cubic centimetres of saline) of the soluble salts by means of a large syringe.

(*e*) *Combined Treatment, Quinine and other Drugs.*—If perchance it is found that some cases relapse even after an intravenous course, then it seems to me that one would be justified in combining the quinine administration with other drugs which have some curative influence, such as methylene blue and arsenic preparations —"606," neosalvarsan, etc. Werner (1914) claims to have had considerable success with this combined treatment in quinine-resistant cases. *Vide* also Chart 17. In blackwater fever cases with parasites, and where quinine is dangerous, one would certainly be justified in resorting to the latter drugs. I believe that "606" has been given in blackwater fever cases in the Malay States with some success.

(*f*) *The Single Large Dose Method.*—It has been stated that a cure can be obtained by giving one single large dose of quinine equal to one grain for every two pounds of body weight. A man weighing 10 stones (140 pounds) would, therefore, require one dose

of 70 grains. There can be little doubt that this would occasionally cure early cases, but I feel certain that such a mode of treatment would result in many failures. I say this because most of the comatose cases which came under my care received in reality massive doses of this nature. Some received forty grains rectally and forty grains intramuscularly, others received forty grains intramuscularly or hypodermically (quinoforme Lacroix), and this was repeated after twelve hours, amounting to eighty grains in twenty-four hours. In all these cases, however, parasites though scarce, could be found for one to two days later in the peripheral blood, and doubtless they were more numerous in the spleen and bone marrow. Moreover, the gametes cannot be abolished by even several such massive doses. This is sufficient to indicate the unlikelihood of complete sterilization of the blood after a single massive dose. I believe that many relapses would follow after such a treatment. Another point against such a massive dose is the danger of precipitating an attack of blackwater fever, more especially in malignant tertian cases. It seems to me that such excessive doses may be dangerous and are only justifiable in extraordinarily severe and resistant types of the disease, and in comatose cases where it is essential to fell the malady as rapidly as possible in order to save the patient's life.[1]

(*g*) *Further Remarks on Routine Oral Administration.*—The routine treatment which we adopted with great success in Liverpool was the administration of quinine hydrobromide gr. x, three times daily in solution by the mouth for a continuous period of three weeks.

The solution was made up as follows:—

Quinine hydrobromide..		gr. x.
Acid hydrochromic		mm. x.
Aquam	ad	℥ j.

Routine treatment: ℥ j. t.i.d. for three weeks.

The hydrobromide was used with the idea that the bromide radicle would tend to combat the symptoms of quininism.

I have already given reasons why this amount of quinine should be given daily and why it should be continued for three weeks.

In Panama the routine treatment was fifteen grains t.i.d. in

[1] It has been pointed out by Bass that one must not give too large doses of quinine in comatose cases. Single large doses exceeding fifty to seventy grains tend to produce narcosis and to weaken the respiration. Excessive doses may therefore deepen the coma and kill the patient.

solution by mouth for a continuous period of at least three weeks.[1] Other experts recommend thirty grains daily for the first week, twenty grains daily during the second week, and ten to fifteen grains daily during the third week. Thereafter they recommend the continuation of treatment in small doses of, say, five grains daily for another two months.

There can be no doubt that the more quinine that is given continuously the more likelihood is there of obtaining a complete cure. At the same time I fail to see why one should continue to give small doses which are known not to be curative. If you are doubtful about the case after three weeks then rather give some extra weeks treatment with at least fifteen grains daily. If the parasites are nearly dead rather continue to give them more or less full doses of poison than small non-poisonous doses of five grains daily.

Nathan Barlow (*vide Trop. Dis. Bulletin*, 1915) recommends as a routine treatment thirty grains for two days, thereafter fifteen grains daily for one month and fifteen grains twice a week for two additional months. He gives the following interesting table of the results of such treatment for varying periods of time :—

Duration of treatment	Number of patients	Relapses
Less than one month	116	116
One month	246	91 (37 per cent)
Three months	218	0

Sir Ronald Ross often recommended that our Liverpool patients should continue to take about fifteen grains of quinine daily for two months after their discharge from hospital. There can be little doubt that the duration of treatment is very important in the prevention of relapse. The *therapia magna sterilisans* of Erlich may be possible in the future, but so far it is a failure not only with regard to syphilis and trypanosomiasis, but also in the case of malaria and amœbic dysentery. Such a rapid cure is only possible in extremely early cases. With regard to malaria the balance of evidence is certainly in favour of prolonged treatment for three months with moderate doses, fifteen grains daily or less often during the last two months. There can be no doubt that this prolonged treatment will give a very high percentage of cures, but it should be remembered that it is not infallible. I know of an officer from Salonica who received thirty grains of quinine daily for the first month, twenty grains daily for the second month, and

[1] It would appear that the Salonica cases of malaria are unusually resistant, so that the more severe Panama routine may perhaps be necessary.

fifteen grains daily for the third month. He relapsed one month later after an operation. Evidence of this nature inclines me to the belief that the Salonica cases are particularly resistant. The vast majority of them are benign tertian cases. Nathan Barlow's cases were largely malignant tertian, as were also the majority of our cases in Liverpool. It is possible, therefore, that benign tertian malaria is more liable to relapse than malignant tertian. On the other hand, it must be remembered that the cases invalided to England are the difficult, resistant and long-standing cases, often complicated with wounds and other diseases.

The most important point of all is to begin treatment early and to avoid the intermittent use of quinine. Do not play with the parasites by half killing them with the drug and then allowing them a few days' respite to recover from the poison. If you allow the parasites to recover, so that they commence multiplying once more, then it is necessary to start treatment all over again from the beginning, and this time possibly the parasites have developed some resistance to the drug; therefore always treat early, thoroughly and continuously for at least three weeks, and more lightly for two additional months if possible.

(12) Other Important Points in Treatment in Addition to the Administration of Quinine.

When a malaria patient was admitted to our ward with fever, he was immediately put to bed with plenty of blankets and surrounded with several hot-water bottles wrapped in flannel. In addition he was given large quantities of hot imperial water to drink. This treatment induces the patient to perspire freely and is very comforting and brings great relief. A dose of phenacetin or aspirin will also help to relieve the headache. It is also important to give a purge at once, four or five grains of calomel, followed later by a dose of salts.

During fever of course the diet consists of hot fluids, soup, etc., but as a rule as soon as the paroxysm is over light diet can be given. A few days later a full diet should be given.

Malaria is sometimes accompanied with albuminuria. This is more common with the quartan variety. Hence it is always best to keep the patient in bed during the first week of treatment. During the second week he may be allowed up indoors, and the third week he may go about a little outside if the weather is fine. It is highly important, however, to avoid fatigue and exposure to cold or damp during the treatment.

Exposure and fatigue are most potent in bringing about relapses and also most potent in precipitating attacks of blackwater fever. For these reasons Dr. G. C. Low, of the London School of Tropical Medicine, strongly advises that all patients should be kept strictly in bed during the whole of the first fortnight of treatment. He also gives arsenic (liquor arsenicalis) in small doses in addition to routine quinine. He states that the arsenic is very good in chronic and anæmic cases, and that it is very potent in reducing the spleen in cases with splenic enlargement. He begins with two minims of liquor arsenicalis, t.i.d., and gradually increases the dose. I agree entirely with this additional treatment, for although with quinine alone the hæmoglobin percentage and the health of the patient increases in a most remarkable manner, nevertheless it is well known that small doses of arsenic act as a very fine blood tonic.

Blood tonics should be continued for some time, especially iron and arsenic.

(13) The Importance of Early and thorough Quinine Treatment.

If every case of malaria was treated at once in its earliest beginnings by vigorous and thorough administration of quinine, it would be a great boon. The result would be a great reduction in the number of relapse cases. Gamete carriers capable of infecting mosquitoes would become very rare, and this in its turn would undoubtedly help to reduce the incidence of fresh infections. It would result also in a very marked fall in the invaliding rate, since chronic and cachectic cases would be practically non-existent. Moreover, enlargement of the spleen and liver would be very rare. The number of cases of blackwater fever would also be greatly reduced, since this latter complication has been found to occur chiefly in cases who have had malaria off and on for one or two years due to inadequate treatment.

If quinine is not given early and thoroughly, malaria becomes a very exhausting disease. A single and moderately severe paroxysm of fever causes a fall of ten to twenty per cent in the hæmoglobin percentage, with a corresponding diminution in the number of red blood cells. In untreated or badly treated cases of some standing it is quite common therefore to find the hæmoglobin percentage as low as forty to fifty per cent. When treated early with quinine the hæmoglobin rises to normal with great rapidity, but in old-standing chronic cases the rise comes about much more gradually.

Malarial fever is not a very fatal disease. The direct mortality is low, even in badly treated cases. But the indirect mortality from malaria is very high, because, if neglected, the system is greatly lowered and enfeebled and such subjects with low resisting power become the victims of other diseases such as pneumonia, phthisis, etc. With the reduction of malaria in a tropical community it has been found again and again that nearly all the other diseases are reduced as well and the death rate falls very markedly in consequence. Prevention is better than cure, so that prophylaxis by mosquito reduction is the most important measure in a malarial community, but next to this in importance is the early and thorough quinine treatment of all cases from the first onset of the fever.

(14) THE NECESSARY AND MINIMUM QUININE TREATMENT REQUIRED TO KILL OFF THE GAMETES IN MALARIAL CARRIERS, SO AS TO RENDER THE LATTER NON-INFECTIVE TO MOSQUITOES.

The gametes, male and female, are the sexual forms of the malarial parasite. When the anopheles mosquito sucks the blood of a human patient containing these gametes, fertilization occurs in the mosquito's stomach. This is the beginning of the sexual cycle of the parasite. The mosquito becomes infective to human beings about twelve days later. If, on the other hand, the mosquito sucks the blood of a human patient containing only the asexual or fever forms of the parasite and no gametes, it will not become infected with the parasite. Chronic malarial carriers are therefore more dangerous than the acute fever cases.

The gametes or sexual forms of the parasite vary in appearance according to the species of the disease. In malignant tertian malaria they are crescentic or sausage-like in shape. The female gamete is more slender and crescentic than the male and the pigment is concentrated. The male gamete is more ovoid in shape and the pigment is more scattered.

In benign tertian and quartan malaria, the gametes are spherical and are liable to be mistaken for adult asexual parasites. They are easily distinguished, however, from the latter, for the gametes, although they always fill the entire red cell, yet show no segmentation of the chromatin. The chromatin is in one mass and the pigment is abundant and scattered. On the other hand the adult asexual forms, which are large enough to fill the red corpuscle, show segmentation of the chromatin and also concentration of the pigment (*vide* Diagram C).

Gametes are not always found in the blood of every malaria patient. In early acute cases they are comparatively rare. I found crescents at some time or other in seventy-five per cent of our malignant tertian cases, but in many of these the numbers were very small, often less than 100 to 200 per cubic millimetre of blood. This number, however, is amply sufficient to infect a mosquito, since a mosquito can suck more than a cubic millimetre of blood. Rarely the gametes were more numerous, amounting to some thousands per cubic millimetre. The highest number we recorded was 7,000 crescents per cubic millimetre. Gametes do not cause

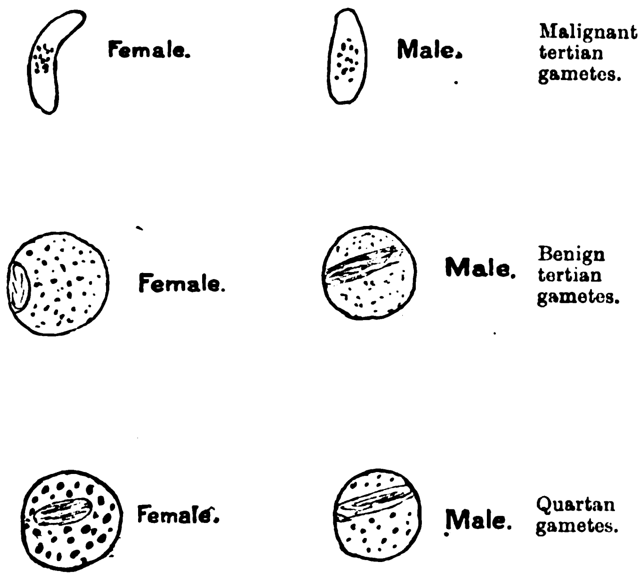


DIAGRAM C.

any fever symptoms: a patient may be walking about and feeling quite well and yet have large numbers in his blood: as a rule they are associated in the blood with small numbers of the asexual forms insufficient to cause any fever. More rarely they are found in acute cases with fever and many asexual parasites. The gamete case, however, is essentially the chronic badly treated case. They are most commonly found in patients in whom the disease has abated or is becoming latent, in patients who have had occasional doses of quinine or quinine in insufficient amount, *vide* Thomson, D. (1911 and 1914). It would appear that when the asexual form of the parasite begins to find life difficult due to occasional doses of

quinine or due to the development of natural resistance, they transform themselves into the sexual gamete type and remain passive in this form awaiting transference into another host—the mosquito. In rare cases, however, they appear very early in the very acute cases. The gametes develop to maturity chiefly in the spleen and

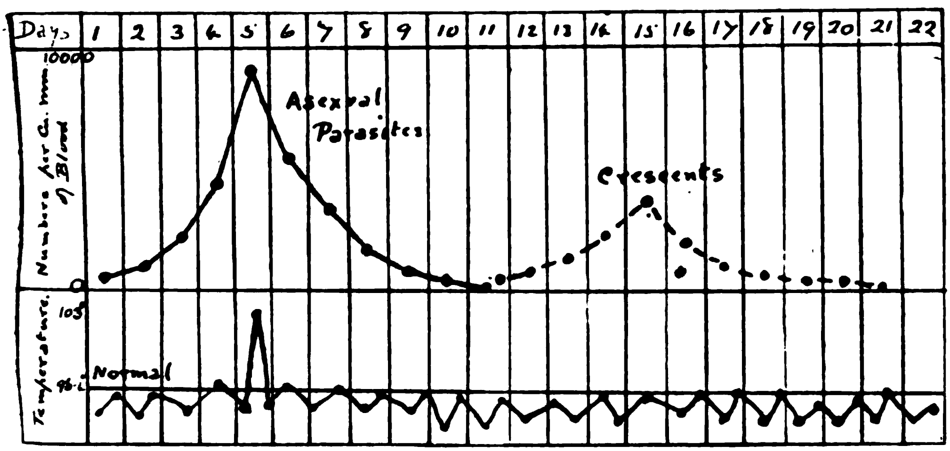


DIAGRAM A. (Single fever paroxysm.)

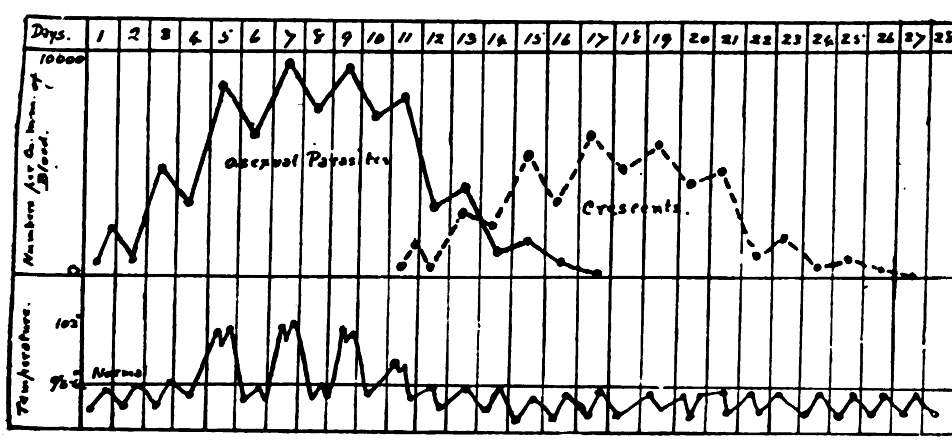


DIAGRAM B.

bone marrow and when completely grown they begin to circulate in the peripheral blood. It would appear that they take ten days to grow to maturity in the inner organs. A paroxysm of fever is frequently followed by a brood of crescents which appear in maximum numbers in the circulation ten days later as shown in Diagrams A and B.

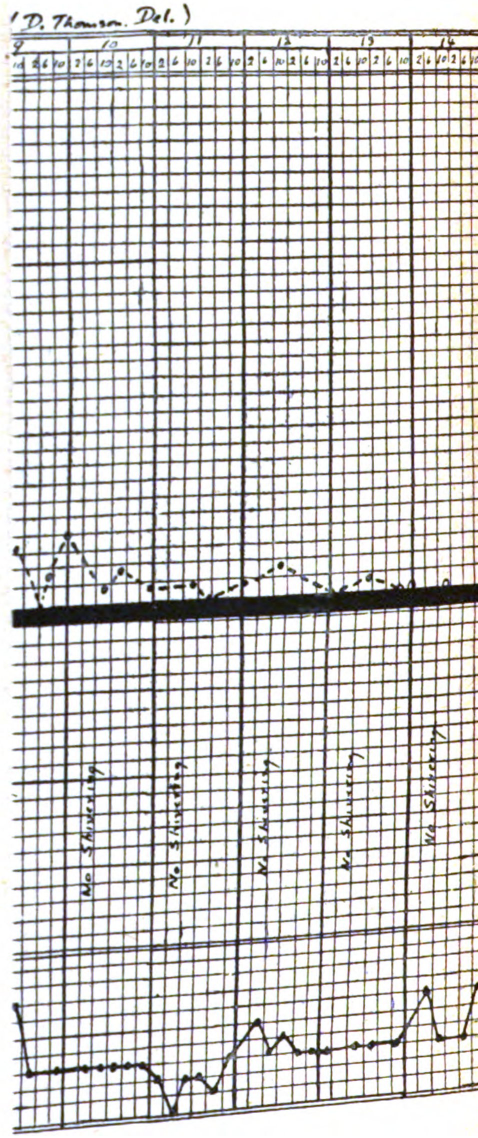
Quinine when given even in large doses (thirty grains daily) has no direct destructive effect on the crescents or other gametes. It would appear, however, that if this amount is administered daily just before, during, and after the paroxysm of fever the subsequent formation of crescents will be greatly reduced. The cases showing the greatest numbers of crescents had little or no quinine for several days previous to the producing paroxysm of fever and little or no quinine during that paroxysm (*vide* Charts 11 and 12), see vol. xxviii, pp. 680, 682.

Crescents and other gametes gradually disappear under continuous routine quinine treatment. This is not due, however, to the direct destructive effect of quinine upon them. All that the quinine does is to stop the further production of crescents by destroying the asexual parasites from which they arise. The source of crescents is cut off and those which remain gradually die off and disappear from the circulation within three weeks from the commencement of the treatment[1] (*vide* Charts 13 and 14). In Chart 14 it should be noted that the crescents found in the blood during the course of the treatment were still alive, as they could be induced to flagellate every day as observed in wet cover-slip preparations under the microscope.

Crescents may continue in the blood for several months in latent untreated cases, or in cases which have received only a few doses of quinine (see Chart 11). This is due to the fact that the asexual forms are also present, and these keep on producing more crescents, and thereby constantly replenish the supply in the circulation. In some fifty cases carefully investigated, however, we found that routine quinine (thirty grains daily) for three weeks never failed to reduce the numbers below one per cubic millimetre of blood, and very often they disappeared much more quickly, within a week or less. In attempting to study the effect of drugs on crescents or other gametes, it must be borne in mind that the numbers of these sexual parasites vary naturally in a remarkable manner, as already depicted in diagrams A and B. They come into the peripheral circulation in broods or outbursts from the inner organs (spleen and bone marrow) daily, every other day or irregularly, according as the fever ten days previously had been quotidian, tertian or irregular in type. Chart 13 shows quotidian outbursts resulting from previous quotidian paroxysms of fever. One of our fifty cases, Chart 15,

[1] At any rate they are reduced in three weeks to numbers less than one per cubic millimetre, so that the blood is no longer infective to mosquitoes.

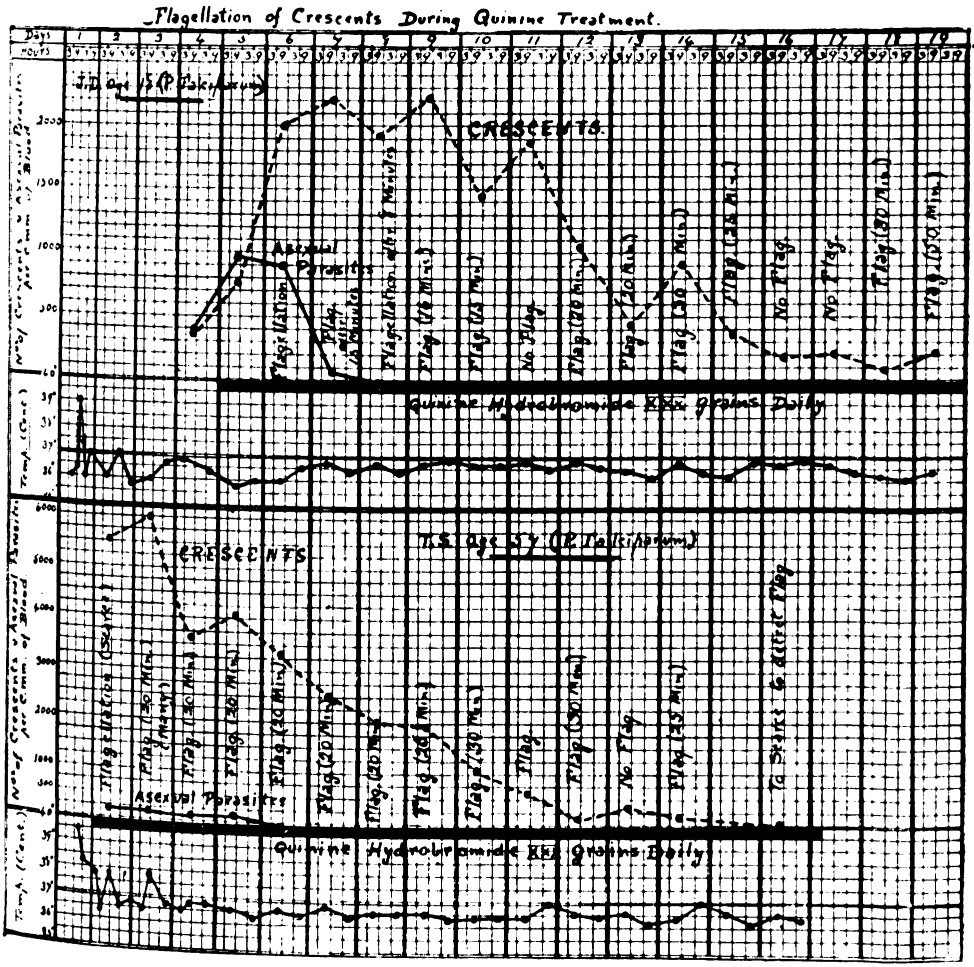
(D. Thomson. Del.)



showed a definite tertian variation in the number of crescents, but more usually the variation is very irregular.

These points must be remembered when testing the effect of drugs. Rogers (1917) described the more or less rapid disappearance

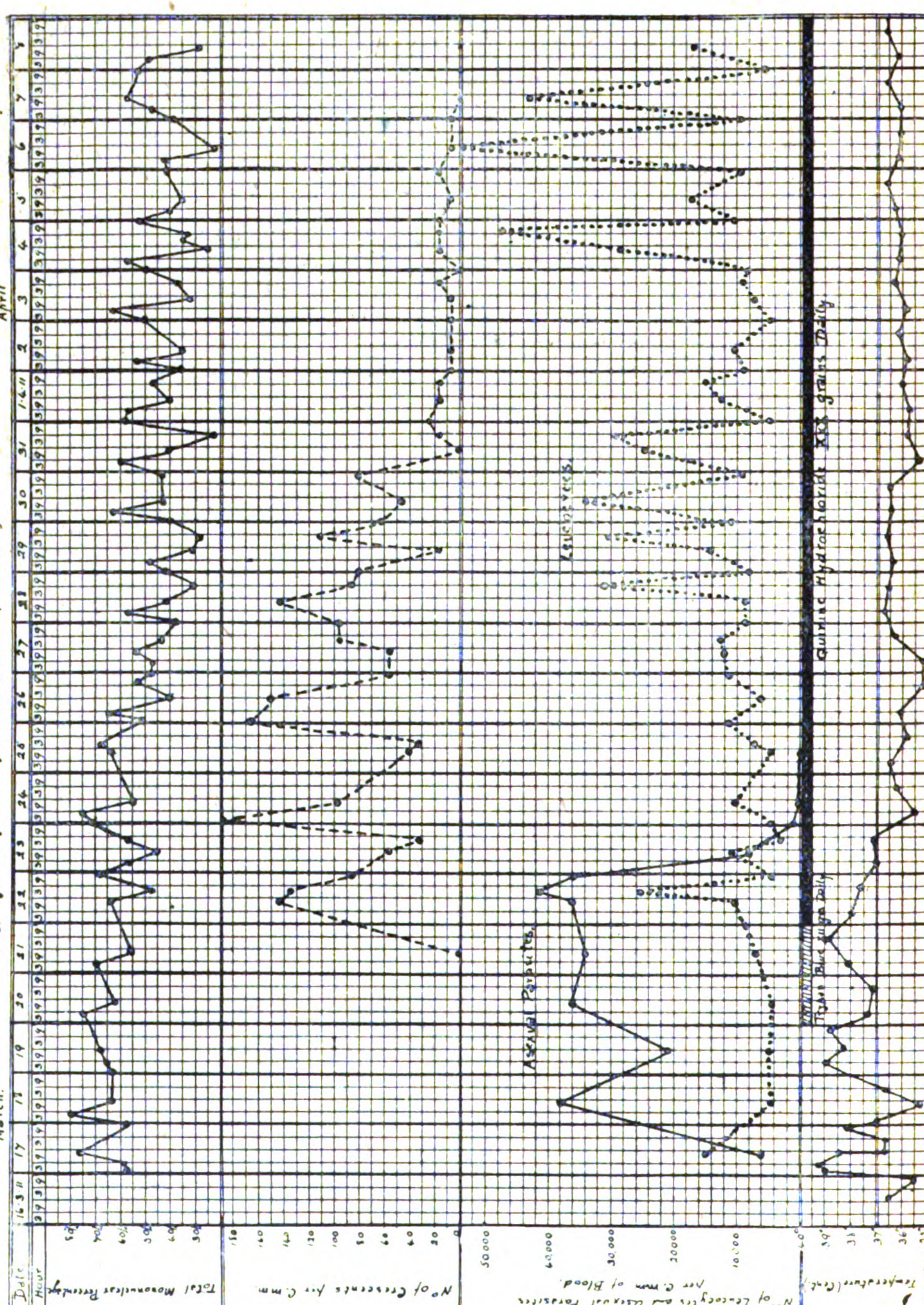
CHART 14.



of crescents from the blood of three patients who were treated with intravenous injections of tartar emetic. Low (1917), however, tested the effect of these injections on one of his cases; the following is a quotation from his paper: "A study of the table shows that

CHART 15.

H. S. age 35. (P. falciparum.) (Tertian outburst of Crescents.)



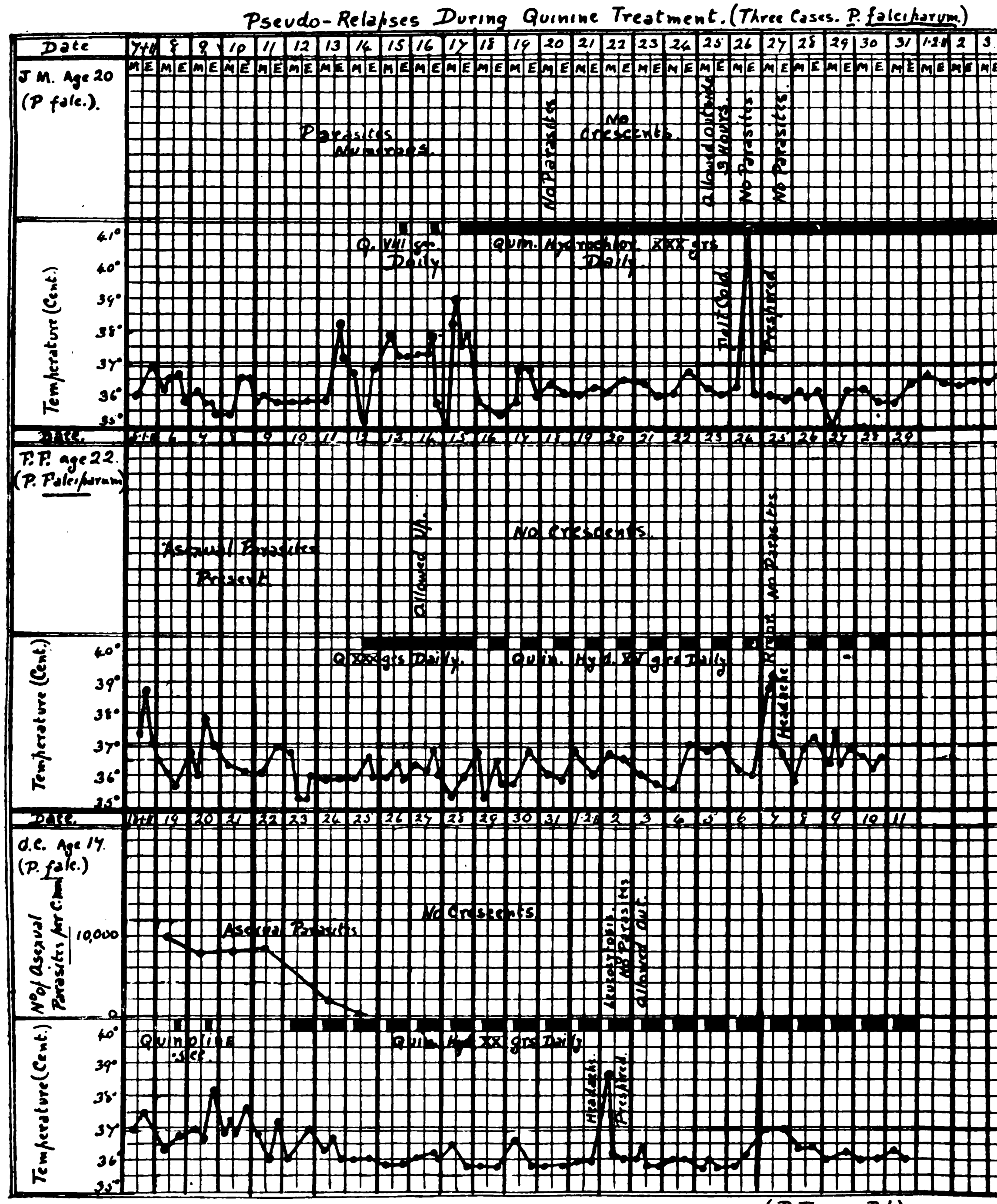
the antimony had not the slightest effect on the crescents, their numbers fluctuating up and down quite irrespective of the injections. Six intravenous injections in all were given, beginning with one grain and increasing to 2½ grains, the last three consisting of the maximum dose. That the parasites were not dead was proved by the fact that they were alive and active in fresh blood, and proceeded to flagellation in a normal manner. In addition to the crescents a scanty ring infection was also present; again the drug appeared to have no effect upon them. After it was seen that no good was accruing to the patient from the antimony, he was put upon quinine and increasing doses of arsenic, and the beneficial results of these are also brought out in the table." I believe that tartar emetic has also been recently given to patients at the Liverpool School of Tropical Medicine without effect. It seems likely, therefore, that Rogers' cases happened to be some of those in which the crescents disappeared quickly from the blood naturally as occurs quite often. He was quite aware of this fallacy, but he considered that this occurrence in three successive cases seemed promising enough to deserve further trial and experiment. It is evident, however, that the routine quinine given as already described is the best known means of destroying the gametes,[1] and not only, therefore, does this treatment give a reasonable guarantee of a cure, but it also renders the gamete carriers non-infective to mosquitoes, which is indeed a very important matter.

(15) Pseudo-relapses in Malaria.

There seems to be a current belief that relapses may occur quite frequently in cases of malarial fever even during continuous quinine treatment. Caccini (quoted by Ross, 1910) states that a relapse occurred in fifteen per cent of 1,002 cases which had quinine daily. We cannot, however, find accurate data regarding all these relapses, as to whether parasites were found in the blood during the relapse, or how much quinine had been given, or for what period. With regard to our 200 cases where quinine was given in doses of ten grains thrice daily, it was almost impossible to find asexual parasites in the blood after three to five days of the treatment, no matter how numerous the parasites were before treatment was commenced. In no case except one did we ever discover a re-appearance of these parasites while this dosage was continued. This one exception will be described under the next paragraph.

[1] We found that methylene blue in doses of twelve grains daily in pill form was also potent in causing crescents to disappear.

CHART 16.


Pseudo-Relapses During Quinine Treatment. (Three Cases. P. falciparum)
Date
J. M. Age 20
(P falc.).
Parasites Numerous.
No Parasites
No Crescents.
No Parasites
No Parasites
Temperature (Cent.)
Q. VIII grs Daily
Quin. Hydrochlor. XXX grs Daily
Felt Cold
Freshened
T. P. age 22.
(P. Falciparum)
Asexual Parasites Present.
Allowed Up.
No Crescents.
No Parasites
Q. XX grs Daily.
Quin. Hyd. XV grs Daily
Headache
D. C. Age 17.
(P. falc.)
No of Asexual Parasites per C.mm
10,000
Asexual Parasites
No Cresents
No Parasites
Allowed Out.
Quin. Hyd. XX grs Daily
Headache
Freshened
(D. Thomson. Del.)

It would appear that so far no drug has been found with so great a curative power in any disease as that of quinine in malaria, unless perhaps emetine in amœbic dysentery and salvarsan in syphilis. But quinine is superior to the latter specifics in that it is much less toxic and safer to administer.

I would like, however, to call attention to apparent relapses occurring during quinine treatment (see Chart 16).

In 6·7 per cent of our cases, a sudden isolated rise of temperature occurred during the quinine treatment, accompanied sometimes with a feeling of cold and slight shiverings. No asexual parasites could be detected on prolonged search by thick film during these attacks of fever. On one occasion the blood was examined by myself and also by thirteen students, each with microscopes, for over half an hour, yet no parasites either sexual or asexual could be found. All these apparent relapses were, therefore, non-parasitic relapses. One naturally wonders if these are connected in any way with the malarial infection, or if they are due to the quinine treatment, or if they are mere coincidences, the fever being due to some other cause. We investigated the hospital records and temperature charts of one hundred cases of various diseases, not malarial, and found that similar more or less inexplicable isolated rises of temperature occurred in seventeen per cent of them. The diseases in which this occurred most frequently were cases of latent phthisis, cases of valvular heart disease, Bright's disease, chorea, rheumatism and bronchitis. These isolated rises of temperature more or less inexplicable therefore occur in other diseases during treatment as well as in malaria, and it seems possible that they may have no real connexion with the original disease whatsoever. In some of our malaria cases the rise of temperature could be explained by a sudden and transitory inflammation of the tonsils, in other cases it was possibly due to constipation. The rise in some cases did not occur on the proper day, so that was against them being malarial in origin. (*Vide* also Werner, 1914.)

Although numerous, non-parasitic rises of temperature with rigors occur in blackwater fever, and although it has been shown, Thomson (1911), that from the behaviour of the leucocytes one might infer that the malarial virus lingers long in the system in spite of continuous quinine treatment, yet we have no proof that these pseudo-relapses are due to the disease. Some of the relapses during quinine treatment recorded by Caccini may possibly correspond to the seventeen per cent of incidental rises of temperature found in cases not malarial, during treatment in hospital.

(16) THE RARITY OF TRUE QUININE-RESISTANT CASES OF MALARIA.

Cases of malarial fever, resistant to quinine treatment, and which showed relapses during the treatment, have been reported to occur in the Amazon Valley. Amongst our 200 cases only one showed quinine resistance. This case contracted fever in the Amazon Valley. On the other hand, we had twenty other cases from the Amazon which showed no such resistance to the drug. I think we were particularly fortunate to find one such case out of 200, which equals 0·5 per cent. These unusual cases are, probably, much more rare. Only a few such cases have been described and one cannot be certain that all of them were genuine, as often no details were given or any data as to whether or no the case was proved by microscopic examination of the blood. Very often patients with a septic temperature due to, say, liver abscess have been treated as malaria cases. Of course the quinine has no effect and, in consequence, they are considered as quinine-resistant types of malaria. The details of our one apparently genuine case can be studied on the accompanying Chart, No. 17.

It was a mixed case containing both malignant tertian and benign tertian parasites. The duration of illness before admission to our hospital was one hundred and fifty-nine days, during which time he had quinine intermittently. He had had several relapses during that period. It will be noted from the chart that on admission he had 62,000 asexual parasites per cubic millimetre of blood. The patient was very weak and emaciated with only forty per cent of hæmoglobin.

Quinine hydrobromide in liquid form was administered in doses of ten grains thrice daily, by mouth. This reduced the asexual parasites to below the detectable limit in thin films, in five days, that is, about two days longer than usual. This dosage of quinine was continued for seventeen days, during which period the temperature remained normal. From November 3 till November 9 the blood was not examined; on November 10, however, a rise of temperature having been noticed, the blood was examined rapidly and no parasites were observed. Thinking that the temperature was one of those pseudo-relapses mentioned above, we stopped the administration of quinine for a few days. As the temperature however persisted and showed a true malarial type, the blood was again examined carefully from November 14 onwards. Asexual parasites, malignant and benign, were found, and, moreover, crescents began to appear. Quinine was again given on November 15 as indicated

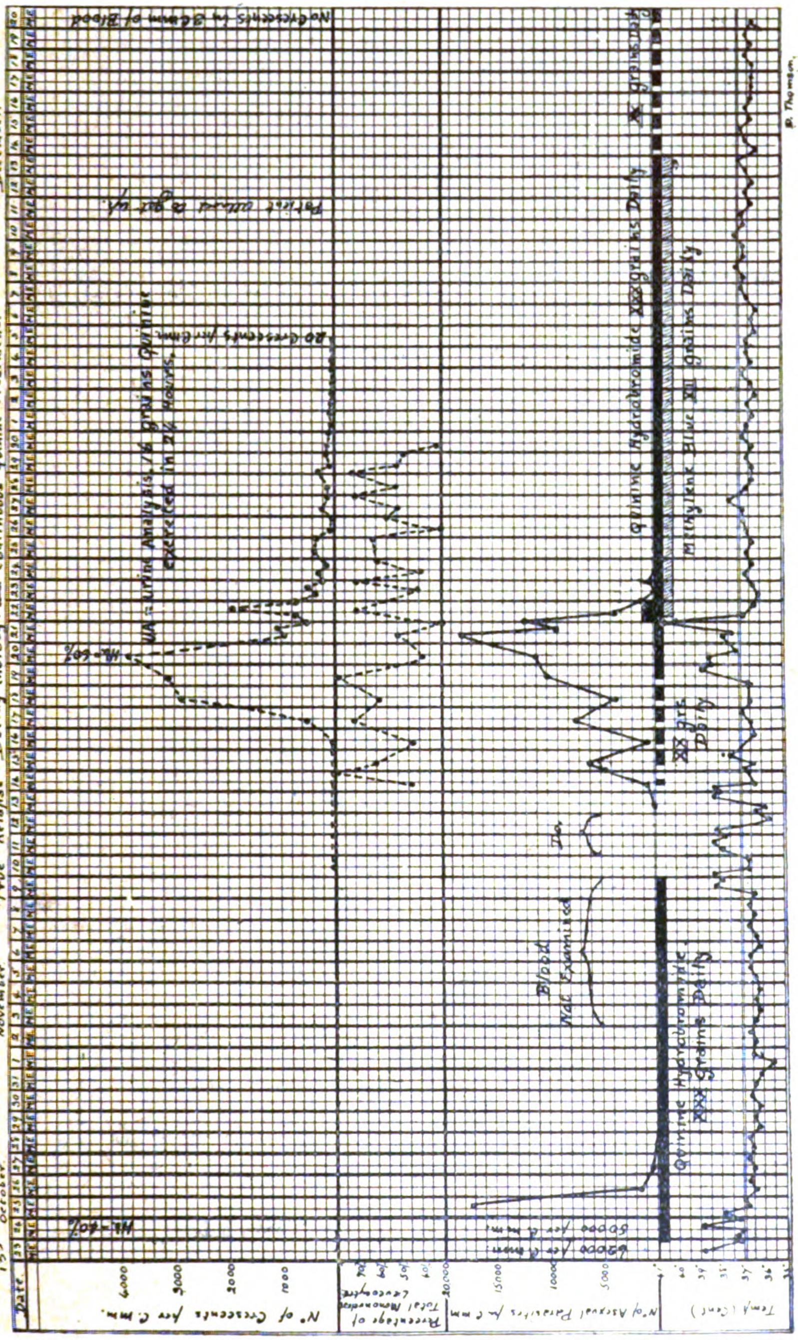


CHART 17.

E. E. age 65. P. falciparum + P. vivax. (Amazon)

True Relapse During thorough and Continuous Quinine Treatment.

on Chart 17. Some days later the patient was very ill and slightly delirious, and seemed to have difficulty in articulation. He commenced to pass his urine involuntarily. On November 21 the fever showed no signs of abating, and on November 22, therefore, thirty grains of quinine bihydrochloride were injected intramuscularly in addition to the usual thirty grains of quinine hydrobromide given by mouth. In addition, twelve grains of methylene blue were given daily in pill form. This combined and more severe treatment reduced the asexual parasites below the detectable limit in three days, and the crescents were reduced to twenty per cubic millimetre in fourteen days. The patient improved very rapidly, and was no longer confined to bed after December 10. On December 13 the methylene blue was stopped and the quinine reduced to twenty grains daily. He left hospital on December 20. On the supposition that the quinine may not have been properly absorbed from the digestive tract in this patient, on November 21 a twenty-four hours' specimen of the urine was examined and the quantity of quinine excreted was estimated. It was found to contain sixteen grains. This is about the usual amount and showed that the quinine administered was being efficiently absorbed. I think there can be little doubt, therefore, that this case showed a very considerable and unusual resistance to quinine treatment.[1] Such cases are fortunately very rare, as I have already stated above.

(17) THE EFFECTS OF THE CURATIVE DOSES OF QUININE ON THE SYSTEM AND THE AMOUNT OF QUININE THAT THE AVERAGE MAN CAN STAND.

Quinine does not as a rule produce such marked symptoms of quininism as one has been generally led to believe. The quinine-resistant case mentioned above was a weak old man of 65, yet in spite of a practically continuous treatment with quinine (thirty grains daily) for fifty days, he had no symptoms of deafness, nor did he complain of any of the symptoms of quininism. Out of our 200 cases most were treated with the routine quinine, thirty grains daily, for a period of three weeks, yet we had few or no

[1] The only possible fallacy is that the patient may not have received the quinine regularly by the nurse as ordered. I had some suspicions with regard to this. She admitted that some doses had been omitted about the time of the relapse. It is possible also that the patient may have rejected his medicine when no one was watching.

complaints of quininism produced by this so-called severe treatment. During such treatment the patients improve in health most markedly. They gain weight rapidly, and the hæmoglobin percentage rises very quickly. They have always been able to hear well and during the second and third weeks they were able to work well in the ward. It is, however, not advisable to inform the patient as to the quantity of quinine that is being administered, for if they think the dose is large they are apt to complain. It would appear that the majority of patients felt no more inconvenience from doses of thirty grains daily than from doses of ten to fifteen grains daily, more especially after the first few days of administration. The average patient can therefore tolerate, with very little discomfort, much more quinine than is generally supposed, especially when they are not aware that they are receiving heroic treatment. I believe it has been stated somewhere that large doses of quinine tend to make the red corpuscles less stable, so that they tend to hæmolyse more easily. There would not appear however to be much support for this in our observations. During the three weeks of routine treatment the hæmoglobin often rose in our cases as much as forty per cent. One patient volunteered to test how much quinine he could take in a day. He took in one day 100 grains[1] without any harmful symptoms and made no complaints. The hæmoglobin percentage and red cell count were estimated before and after and no difference was noted. On the other hand it must be remembered that some rare people have a marked idiosyncrasy to quinine. Very rare cases have been recorded in which a few grains were sufficient to produce alarming symptoms. Such cases are fortunately exceedingly rare, since out of the millions of cases treated in the world extremely few have been recorded. Quinine is certainly not a particularly deleterious or toxic drug to the average human being. Men from the tropics have told me that it is all very well to give large doses continuously in a temperate climate, but that such doses are much more severe in the heat. On the other hand I have been told that men can tolerate quinine much better in the hot than in the cold climates; so I think there can be very little difference, no matter what the climate is. In the tropics the vitality of a white man

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[1] This quantity was taken in three doses at intervals of five hours. Very large single doses of fifty grains and upwards usually cause vomiting and may render the patient semi-unconscious with slow and feeble respiration.

is often somewhat lowered, so perhaps it is more severe on him; on the other hand it should be excreted more quickly due to more excessive perspiration.

(18) The Inferiority of other Drugs compared with Quinine.

In the treatment of malaria there is no drug known which can in any way approach the remarkable efficiency of quinine. It is vastly superior to arsenic, antimony, methylene blue, trypan-blue, picric acid, etc. Of these drugs methylene blue is probably the best. In doses of twelve grains daily it exerts a considerable curative effect by killing off the asexual parasites, and although in this respect it is much weaker than quinine, yet it is always useful to have such a standby in case of intolerance or resistance to the latter drug. Trypan-blue, which is so effective against the *Piroplasma canis* did not show any power against malaria in the few cases in which we administered it (see Charts 14 and 15). With regard to arsenic, soamin injections were of no avail. Injections of salvarsan have been tried by several workers. After the injection the asexual parasites may disappear for a day or two, but they always reappeared again with a consequent relapse. Injections of tartar emetic, as already stated were found to have little or no effect against either the asexual or sexual forms. Picric acid was supposed to have a destructive effect on the sexual forms or gametes, but after several experiments we found that it was useless in this respect. Failing quinine, therefore, the only drugs we can turn to for help are methylene blue and arsenic.[1] As already stated, it is good to give arsenic in the form of liquor arsenicalis along with the quinine treatment.

The Effect of Quinine Derivatives.—Towards the close of our researches in Liverpool we had commenced to test the effect of the various quinine derivatives or radicles. Quinine has a very complex molecule and it is possible that certain parts of this molecule are the potent radicles against the malarial parasite. It is conceivable therefore that if the molecule were broken down into simple compounds some of these might be even more powerful than quinine itself. With this idea we tested various substances which have been derived from quinine. Several of these substances

[1] Nathan Barlow (1915) states that an intravenous injection of $\frac{1}{4}$ grain of mercuric chloride has a destructive effect on the parasite.

with which the chemist supplied us were, however, unfortunately extremely nasty and irritating and had to be given in gelatine capsules. They were much worse to take than the quinine itself and also apparently more toxic. This part of our research was unfortunately not completed, but the results obtained were the following:—

Thallin sulphate	20 grains daily by mouth	.. No effect.
Chinoline sulphate or chinconine ..	30 ,, ,,	.. ,,
Chinosol	15 ,, ,,	.. ,,
Coumaric acid	20 ,, ,,	.. ,,
Analgen	15 ,, ,,	.. ,,
Cryogenine	30 ,, ,,	.. ,,
Loretin	15 ,, ,,	.. Apparently some curative effect.
Quinoline	0·5 cubic centimetre daily by mouth	.. Apparently some ourative effect.

Other Remedies tested:—

Picric acid	6 grains daily by mouth	.. No effect.
Picrate of ammonia	6 ,, ,,	.. ,,
Sodium glycocholate	30 ,, ,,	.. ,,
,, cinnamate	15 ,, ,,	.. ,,
Mizarol (a South American patent remedy)	.. ..	.. ,,

X-rays applied over the spleen had also no effect in killing either the asexual or sexual parasites.

During the last four years much further work has been done with regard to the quinine derivatives and other drugs by McGilchrist (1915), Werner (1914), Giemsa and Werner (1914), Mühlens and Gelhaar (1914), Peiper (1914), Baermann (1914), Joyeux (1913), Telang (1917), Lackmann and Weise (1917), etc. (*vide Trop. Dis. Bulletin*). The following results were obtained:—

Chinidin (*Conchinin*).—0·4 gramme daily. As effective as quinine.
Hydrochinidin.—Effective.
Cinchonin and Hydrochinchonin.—Not so effective as quinine.
Chinaethylin and Chinopropylin. 0·3 to 0·4 gramme daily. Very effective.
Quinoidine.—Often better than quinine. No chinchonism.
Hydroquinine.—One gramme intravenously. As effective as quinine.
Ethylhydrocuprein in doses of 0·5 gramme injected intramuscularly was very effective. Not so good intravenously and not suitable orally.
Hydrochloride of Ethylhydrocuprein (Optochin).—One gramme daily in small doses. Very effective.
Isopropylhydrocuprein Hydrochloride.—0·2 gramme three or four times daily. Very good.
Cuprein.—Feeble action.
Isoamylhydrocuprein.— Feeble action.
Isopropylhydrocuprein and Isoamylhydrocuprein bases.—No effect.
Hectine B.—Intramuscular injections good, but not so potent as quinine.

Arsalyt (arsenic preparation) by intravenous or intramuscular injection, 0·1 gramme to every ten kilos of weight had some effect but did not prevent relapses.

Calomel by mouth some effect and *Mercuric chloride* ¼ grain intravenously also effective.

(19) THE UNSATISFACTORY FACTS ABOUT QUININE PROPHYLAXIS.

Some years ago there was a considerable controversy regarding the respective merits of mosquito destruction and quininization of the population as a means of preventing or reducing the incidence of malaria. Prevention by anti-mosquito measures as recommended by Ross has, however, proved to be vastly superior. Mosquitoes are a pest and cause much inconvenience, quite apart from the malaria they convey and, moreover, they carry other diseases as well, so anti-mosquito measures are desirable for more reasons than one. In some cases, however, where the population is sparse and scattered and where swamps and other mosquito-breeding places abound, the reduction of mosquitoes may seem hopeless. In such circumstances quinine prophylaxis may have to be adopted as the chief measure. No matter what the circumstances may be, however, some attempt should be made to combat the incidence of the disease by both methods. It is obvious that the two means of prevention complement each other and are better than one alone. Mosquito destruction destroys one stage of the parasite along with its host, but the human population already infected remain so, if untreated, for months, and sometimes for years. To relieve these, quinine must be given and, if the amount given is adequate, not only are they relieved of their sickness, but the gametes, crescents, etc., are destroyed, so that another link in the perpetuation of the disease is broken. This point, however, is usually considered more under the province of treatment than of prophylaxis, though it is easy to see how very important it is to treat all cases of malaria thoroughly in order to assist in breaking the chain of the disease for the purpose of preventing its spread in a community.

Quinine prophylaxis, however, is the term used where small doses of the drug are administered to the uninfected subjects in a malarial community in order to safeguard them against infection from mosquitoes. It has been generally believed that five grains of quinine administered daily will help much to prevent infection from mosquitoes. This amount, however, is insufficient to give any guarantee against infection, as I have known several cases of primary attacks of malaria contracted during this daily dosage. Stott (1916) after a prolonged investigation was forced to conclude

that doses of ten to fifteen grains given three times a week gave no protection. My own idea about quinine prophylaxis is that immunity against malarial infection or prophylaxis cannot be guaranteed unless the quinine is given daily in curative doses, twenty to thirty grains daily. This, however, is not practicable during a prolonged stay in a malarious country, as it means that the prevention is nearly as unpleasant and much more prolonged than the cure. On the other hand, although it is possible that five grains daily will prevent infection in a certain number of cases, yet this good is undoubtedly overshadowed by the danger that the disease in certain other cases will be contracted and remain latent, and also by the further danger of producing gamete carriers. I have already described the danger of administering small doses of quinine in this respect under the heading of Treatment.

It seems to me, therefore, that quinine prophylaxis is not such a simple matter as was formerly supposed, and, in consequence, a considerable amount of judgment is necessary to carry it out in a manner sufficiently practicable, scientific and certain to guarantee results. It is foolish to give quinine prophylactically when the subject is not in any danger of being bitten by mosquitoes; for example, it used to be recommended that a person going to the West Coast of Africa should commence taking quinine on the ship before he actually reached the coast. This, in my opinion, is unreasonable and quite unnecessary. It seems to me that quinine might be taken prophylactically in moderate curative doses, say fifteen to twenty grains daily, when a person is much exposed and quite unable to protect himself against mosquitoes. It is obvious, however, that this curative dosage cannot be continued for long. It is conceivable, however, that it might be of great value in certain circumstances where people were going to be exposed to infection from mosquitoes for only some seven to ten days. It is possible that soldiers might be exposed in a trench for some ten days and then relieved and sent back to a rest camp in a healthy locality where they would be protected from mosquitoes. In such an eventuality it would be sensible to administer twenty grains of quinine daily to the soldiers in the trenches and then stop as soon as they were returned to the healthy area.

I consider it best to give prophylactic quinine at night just before going to sleep, for two reasons: First, because (since quinine is rapidly absorbed in one to two hours) it insures that the system will be well saturated during the night, when the mosquitoes are

most active in biting; and second, because the unpleasant effects of the drug will pass off during sleep.

I am strongly against the indiscriminate administration of small doses of quinine, say five grains daily, to a population. This no doubt keeps down the actual appearance of malaria to some extent but one might just as well give occasional doses of "606" to a syphilitic population in order to keep the disease more or less invisible to the casual observer or to the patients themselves. It seems to me like the case of the ostrich which puts its head into a hole and thereby imagines that danger is not at hand because it cannot be seen. Surely it would be vastly more reasonable, scientific and effective to carry on anti-mosquito measures to the utmost that is possible, and to treat early and thoroughly every person in whom malarial manifestations were present. In doing this, the vicious chain of the disease is attacked at two points, since it means the reduction of gamete carriers as well as the reduction of mosquitoes. This was the method adopted in Panama with such striking success. Though unaware of the full danger of quinine prophylaxis they gave it up. Free quinine could be obtained in every mess room by any one who desired it, but it was never urged that it should be habitually used and it was seldom taken.

(20) Some Notes on Blackwater Fever.

Blackwater or hæmoglobinuric fever is a very remarkable and mysterious disease. It is almost a proved certainty, however, that it is due to malaria. It may be in fact regarded as a tertiary manifestation of the disease. It usually occurs in subjects who have suffered from frequent attacks of malignant tertian malaria for some two years or more. Some cases have been described as coming on very early, but these are rare, so it may be stated with considerable confidence that the incidence of blackwater fever would be greatly reduced if all malaria cases were given a curative treatment as early as possible after the commencement of the disease.

An attack of blackwater fever (see Chart 18) consists essentially in a sudden hæmolysis of the blood. In a severe case the majority of the red cells in the body suddenly break down. The hæmoglobin may fall some 80 to 90 per cent in twenty-four hours with a corresponding diminution in the number of red corpuscles. The patient becomes blanched and the blood is almost milky in colour. The liver is unable to cope with this sudden blood destruction and

marked hæmatogenous jaundice is the result.[1] A severe strain is also thrown upon the kidneys. They attempt to excrete the free hæmoglobin. In consequence the urine becomes black like porter, or in less severe cases port-wine in colour. The tubules of the kidneys are liable to become blocked up with blood pigment and débris, and this is the greatest danger of all, resulting in suppression of urine. If this suppression persists the patient dies. The chief object in treatment therefore is to keep the kidneys clear and acting by means of diuretics. The patient also is so weak that he requires stimulants to tide him over this severe crisis. Champagne may be indicated, also copious saline transfusions are very valuable. Enemas and rectal salines are also useful. Other symptoms in blackwater fever are the severe rigors and high swinging temperature. The temperature often jumps up and down several times daily in a remarkable manner, *vide* Chart 18.

I have said that blackwater fever is a mystery. It is known, however, that an attack is nearly always brought on by exposure and fatigue in addition to quinine administration. It has been proved beyond doubt that quinine may precipitate an attack, more especially when acting in conjunction with fatigue or exhaustion, or when very massive doses are given. I have shown, however, that in healthy subjects quinine, even in enormous doses, does not seem to be capable of breaking down the red corpuscles, and on the contrary that the hæmoglobin percentage increases most markedly under the routine treatment described. It has been stated, nevertheless, that quinine makes the red cells less stable, so that hæmolysis will occur more easily in the presence of this drug. Arsenic, on the other hand, is stated to have the opposite effect. Hence it would be better always to give arsenic and quinine together as recommended by Low.

The sudden hæmolysis, which occurs in blackwater fever, has led me to believe that in these cases there must be present in the system a considerable amount of auto-hæmolysin, so that in certain circumstances, brought about by exposure, fatigue and quinine, this substance is capable of acting suddenly in a very disastrous manner. If this is so, why should this auto-hæmolysin arise after frequent attacks of malaria, and more especially in the case of malignant tertian? My hypothesis is that with every paroxysm of malignant tertian malaria we are liable to get petechial hæmorrhages into the

[1] As a rule there is severe vomiting.

tissues around the small capillaries as already explained. It is unnatural to have red corpuscles constantly extravasated into the tissues, in small doses, hence the tissues produce anti-substances to them, and in the course of time, with ever-repeated attacks of malaria, this anti-red cell substance has accumulated in large amount, so that the stability of the red cells in the blood is in danger of being overcome. It is conceivable, therefore, that where the amount of auto-hæmolysin and the natural stability of the red cells are nearly balanced, a dose of quinine or over-exhaustion may turn the scale in favour of the former. A sudden hæmolysis would be the result, or, in other words, an attack of blackwater fever. Hæmolytic researches in the nature of serum reactions based on the Bordet-Gengou phenomena might prove of great value in clearing up this mystery.

With regard to quinine in blackwater fever, it is dangerous to give it during the attack; on the other hand, this disease arises from previous insufficient treatment of malaria with this drug.

(21) Synopsis of Treatment of Malaria.

(*a*) In all cases, whether acute, chronic or latent, and in cases of gamete carriers, commence a thorough routine treatment as early as possible with the idea of obtaining a permanent cure from the beginning. The treatment may be considered severe, but it pays, and it means that less quinine will be needed in the long run.

(*b*) As a rule early cases will be cured by a routine treatment of ten to fifteen grains of quinine in solution, by mouth, given three times daily for three weeks. When it is suspected, however, that the drug is not being absorbed well, due to gastritis or some other cause, then in addition to this oral routine, inject ten grains daily hypodermically or intramuscularly during, say, the first five and the last five days of this period. It is advisable also to continue the treatment for two additional months with smaller doses (fifteen grains daily).

(*c*) In the case of resistant forms of the disease, or in cases which have relapsed several times in spite of thorough oral treatment, then give a course of intravenous injections as described under paragraph 11 (*d*). If this also fails give a combined treatment, by administering methylene blue as well as quinine [paragraph 11 (*e*)].

(*d*) Always give small doses of liquor arsenicalis, as well as quinine, commencing with two minims t.i.d., and gradually increasing to five minims.

(*e*) Put all acute and subacute cases to bed, with hot-water bottles, and administer hot drinks to induce perspiration. Give also an initial dose of calomel followed by salts to clear out the bowels. During the paroxysm, aspirin or phenacetin may be given to relieve headache and to reduce the temperature. During the routine quinine treatment keep the patient in bed on a moderately light diet for the first week. Give a full diet and allow up during the second week. Allow out of doors if the weather is fine during the third week, but on no account allow any exposure or fatigue during treatment.

(*f*) In pernicious cases with coma or persistent vomiting, inject a considerable dose of quinine at once, at least thirty grains, and repeat this dose if necessary within twelve hours. After the pernicious symptoms have gone, continue with the usual routine treatment.

(*g*) In the event of a patient being markedly intolerant to quinine, give instead a three weeks' course of methylene blue in pill form, twelve grains daily, or try some of the other recent remedies mentioned above.

(*h*) In the Army where it is required that men should be rendered available for work as quickly as possible, give thirty to forty-five grains daily for three weeks as early as possible. Discharge the patient as cured, and allow a short leave for hardening purposes. If it is found that this treatment is followed by a high percentage of relapses, then it may be necessary to develop some system whereby the men discharged from hospital can continue to take smaller doses of quinine for an additional two months while on duty.

(*i*) In blackwater fever cases, stop all quinine, administer diuretics, saline transfusions and stimulants, give liquor arsenicalis, and later iron tonics. In future attacks of malaria in such subjects begin very cautiously with small doses of quinine.

Before concluding this paper I wish to express my indebtedness to the staff of the Malaria Investigation Department at No. 4 London General Hospital, for the facilities they have afforded me in observing the results of their researches. The numerous cases of relapse following practically every mode of quinine treatment which they have so far employed leads me to believe that a more prolonged course of treatment than three weeks will eventually be shown to be the most efficacious.

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PLATE.

Photomicrographs of malignant tertian parasite. Figs. 1 to 3 are from the same culture of *Plasmodium falciparum*, and are all photographed at the same magnification, namely, 1,500 diameters.

FIG. 1.—A photograph of the malignant tertian parasite as seen in the peripheral blood before incubation. No pigment is seen. The small dark mass is the chromatin.

FIG. 2.—The malignant tertian parasite after twelve hours' incubation at a temperature of 37° C. to 38° C. The parasites have grown to at least twice the size. A circular mass of compact pigment is now evident. This photograph illustrates the clumping tendency and seven parasites are seen grouped together. No division into daughter cells has yet taken place. The dark circular area is pigment, and the darker area, towards the margin, is due to the chromatin.

FIG. 3.—The malignant tertian parasite after twenty-five hours' incubation at a temperature of 37° C. to 38° C. This photograph shows well the tendency to clump and the parasites are now seen at all stages of sporulation.

FIG. 4.—Shows two parasites from a smear of the spleen showing segmentation. Thirty-two spores can be counted in the one in the centre of the field.

FIG. 5.—This is a photograph taken from a coloured plate drawn by Dr. Cropper and shows the clumping of the red cells containing pre-segmenting forms of the malignant tertian parasites. This drawing was made from a smear of the peripheral blood (*vide Lancet*, July 4, 1908, and coloured plate, fig. 1). (Magnification about 1,000 diameters).

PUNCTIFORM HÆMORRHAGES OF THE BRAIN IN GAS POISONING.[1]

By Major F. W. MOTT, M.D., LL.D., F.R.S.
Royal Army Medical Corps (T.).

The subject of punctiform hæmorrhages in the brain in gas poisoning has awakened new interest on account of its existence in fatal cases of shell shock with burial, and in cases of death from inhalation of poisonous gases, either as a result of their liberation by explosives in confined spaces, such as mines, trenches and dugouts, or as a result of an offensive gas attack by the enemy. I shall endeavour in this communication to explain the cause of these punctiform hæmorrhages.

In 1907, I published in Vol. 3, Archives of Neurology and Psychiatry, a paper on "Carbon Monoxide and Nickel Carbonyl Poisoning." I came to the conclusion that the nickel carbonyl poisoning was really due to the inhalation of CO employed in the manufacture of nickel. Two such cases occurred of which I had the opportunity of examining the central nervous system, and I found multiple punctate hæmorrhages throughout the white matter of the brain, as you see in the photomicrographs.

In this paper I compared the naked-eye and microscopic appearance of the central nervous system in these cases of nickel carbonyl poisoning with those observed in a case of suicide by illuminating gas, and I considered them to be identical in nature. I also reviewed in this paper the clinical symptoms and pathology of CO poisoning in respect to the findings in the central nervous system and especially the causes which occasioned the hæmorrhages. All three cases died in from four to eight days with the complication of pneumonia. Thrombosis occlusion of cerebral arterioles or venules was considered to be the cause of the hæmorrhages; in one case from the Nickel Carbonyl works an organized thrombus was found in a vessel of the medulla.

In the case of suicide by illuminating gas, admitted under my care at Charing Cross Hospital, signs of cerebral hæmorrhage occurred within twenty hours of commencement of the inhalation

[1] Read before the Pathological Section of the Royal Society of Medicine February 13, 1917.

of the gas, for the limbs became rigid, and a plantar extensor reflex was obtained. At first the temperature on admission was 99° F., but when the rigidity of the limbs and the plantar extensor response was discovered six hours later, the temperature had risen to 105° F., and the pulse and respiration had become very rapid.

The nervous symptoms pointed to the occurrence of the punctiform hæmorrhages found post mortem in the internal capsules, and it may be assumed that the rise of temperature might have been due to the toxæmia coincident with the onset of pneumonia ; for, when the patient died on the fourth day, pneumonia consolidation was found. Full notes of the clinical symptoms and post-mortem findings were reported. Microscopic investigation showed fatty degeneration of the heart and of the epithelium of the convoluted tubules of the kidney. Punctiform hæmorrhages, attributed to hyaline thrombosis of small vessels of the white matter, have been described by [1] Bignami and Nazari in various diseases : e.g., æstivo-autumnal malaria, apoplexy, diplococcal meningitis following pneumonia and measles. It is possible, therefore, that pneumococcic toxæmia was productive of, or associated with, the causation of the hæmorrhages in these cases of CO poisoning.

But I am inclined to think that the CO poisoning alone would be capable of causing the punctiform hæmorrhages for the following reasons : in both cases from the Nickel Works there was evidence of old hæmorrhages in the form of minute round or oval punctiform patches of softening indicative of gas poisoning on some occasion previous to the man being obliged to give up work. And it was legitimate to attribute these symptoms they suffered from, viz. : giddiness, vomiting and headache (migrainous attacks), to the gas poisoning, causing congestive stasis and hæmorrhages. It is well to note that these migrainous attacks are frequently met with in men and officers who have been exposed to those conditions in which CO poisoning might have occurred without fatal results.

From the facts observed in these three cases of CO poisoning, combined with certain anatomical conditions of the blood vessels supplying the white matter of the brain, to which I shall now direct your attention, an explanation can be offered why these miliary hæmorrhages are found in the white matter of the cerebrum

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[1] Sulle encefalite emorragiche e sulle patogenesi delle emorragie miliariche del cervello—per i Dottori Bignami e A. Nazari (con una tavola) "Rivista Sperimentale di Freniatria," vol. xlii, fasc. 1.

and basal ganglia, and not elsewhere in the brain. It must be recognized that a combination of factors may arise in CO poisoning, viz. :—

(1) The heart, owing to the anoxæmia, has to beat faster, and to do more work with less oxygen ; consequently it may undergo fatty degeneration.

(2) There is microscopic evidence of an irritative and degenerative endothelial change in the cerebral capillaries, as shown by mitosis of the nuclei, and a fatty degeneration, made apparent by osmic acid staining. These changes may be due, as Lancereaux suggested, to CO in the serum, but aggravated by the pneumococcal toxin, which is also responsible for a tendency to increased fibrin formation of the blood, and to thrombosis in those vessels in which the anatomical conditions favour the lodgment of emboli, or clotting of the blood from congestive or inflammatory stasis.

I will now show lantern slides of the microscopic appearances of these punctiform hæmorrhages in known cases of CO poisoning, terminating in death by pneumonia.

The first is a section of the corpus callosum, in which the hæmorrhages are so numerous as to be confluent in places.

The next shows these hæmorrhages more highly magnified. A thrombosed ruptured vessel is seen connected with one hæmorrhage. In the centre of the other hæmorrhage is a thrombosed vessel in transverse section.

Miliary Hæmorrhages in Cases of Shell Concussion and Gas Poisoning.

I may now mention that the microscopic appearances found in these cases of CO poisoning, dying with pneumonia respectively after four days, eight days, and seven days, were in all respects similar to the appearances presented by sections of brains received from France notified as dying of shell shock with burial and from gas poisoning; with one exception, and that only differed in the fact that a large part of the hæmoglobin had been converted into chocolate-coloured pigment granules which blocked the small vessels in the hæmorrhages.

Before proceeding to the description of these cases, I will call attention to the anatomical relations of the vessels of the white matter of the cerebrum where these hæmorrhages are found.

Anatomical Relations of the Vessels favouring Capillary Stasis.

The pia mater covering the cortex sends delicate-walled arteries and veins through the cortex to reach the subjacent white matter the arteries consist of short and long vessels which, after giving off fine branches to the interlacing capillary network of the grey matter, terminate in a brush of fine arterioles; the short vessels end in this brush just below the cortex ; the long penetrate deeper, to end in the corpus callosum and the centrum ovale. Each little artery breaks up into a tree, and forms a separate system of delicate arterioles. Each arteriole ends in a round or oval circumscribed area of capillaries, with an emerging vein. These veins do not anastomose. Thrombosis of arterioles or venules would therefore cause capillary stasis and hæmorrhage into the brain substance in a circumscribed area, also escape of blood into the perivascular sheaths of arterioles or venules; a condition generally found to occur where there are punctiform hæmorrhages. Owing to the thin character of the walls of the arteries, it is difficult to decide whether a vessel in section is an artery or a vein. Punctiform hæmorrhages are also found in great abundance in the brain structures supplied by the perforating arteries, especially those in which the opto-striate and lenticulo-striate branches terminate. These vessels give off relatively few branches until they reach their destination in the basal ganglia, and internal and external capsules; they then terminate in a brush of delicate-walled arterioles. Each vessel supplies, as in the case of the cortical vessels, circumscribed areas of capillaries, and the result of embolism, or thrombosis, is the causation of similar small limited areas of hæmorrhage and softening, which, when numerous, may become confluent.

Shell Shock and CO Poisoning.

The brain of a man said to have died from shell shock was handed to me by Professor Keith for examination. The following notes accompanied this brain : Fatal case of shell shock with burial from Captain Armstrong, R.A.M.C., No. 7, Mobile Laboratory, B.E.F. Sent on from No. 1, Mobile Laboratory, No. 8 on Captain Armstrong's list.

Brain of man, admitted unconscious, with history of having been buried by shell blowing in parapet. Remained stertorous for two days and died.

Post mortem : There is no wound of any kind on his body or

head, and no visceral lesion. His ankle on one side was badly "sprained," but there were no fractures. The skull was unfractured, and no fracture of the base could be found. Brain shows multiple punctiform hæmorrhages, and some slight subpial extravasation. No other particulars.

Photomicrographs, illustrating the appearances presented by the brain in this case, have been already published in the Lettsomian Lectures of the Medical Society, 1916.

Having regard to the fact that these punctiform hæmorrhages and hyaline thromboses of vessels were identical in their microscopic appearances to those I had observed in CO poisoning, it occurred to me that the man may have been concussed, and afterwards gassed while lying unconscious and buried.

It may be argued that these punctiform hæmorrhages were due solely to venous stasis and congestion, but I doubt this, for I have neither observed this condition in the number of cases of death from asphyxia, occurring in status epilepticus, nor after prolonged seizures of paralytic dementia, although I have examined the brains, macroscopically and microscopically, in a great number of instances.

A letter to me from the Trench War Committee confirmed the possibility of CO poisoning occurring when a large shell burst in a confined space, such as a dugout or a trench, if incomplete detonation of the explosion occurred. Moreover, it must be remembered that CO is odourless, and may be present in trenches or dugouts without its existence being known.

In the Memorandum on "Gas Poisoning in Warfare," issued by the Director General, Medical Services, British Armies in France, in respect to CO poisoning, it is stated:—

"The lungs show no abnormal changes in cases of rapid death. Small punctate hæmorrhages may be found in the white matter of the brain, and sometimes ecchymosis in the meninges, if the case has been exposed to a concentration of CO sufficient to cause prolonged unconsciousness."

The fact that CO is not found in the blood when the patient is examined does not prove that death was not due to CO poisoning, for after some hours of exposure to air it cannot be detected, and there is little opportunity to make the test for some hours or even days. Captain Dunn read a very interesting paper at the Medical Society on Epidemic Nephritis, in which he showed hyaline thrombosis of the vessels of the alveoli of the lungs and of the glomerular capillaries of the kidney.

In these cases he has observed multiple punctiform hæmorrhages of the brain, which he attributed to embolism by hyaline thrombi. These hæmorrhages present exactly the same appearances as in CO poisoning or gas poisoning. In a letter he has written to me, he states that he has now observed these hæmorrhages in four more cases of nephritis, so that their occurrence in the first case was not fortuitous. "They are of quite similar appearance to those I have observed in phosgene poisoning." He asks whether hæmorrhages of that type are seen in uræmia.

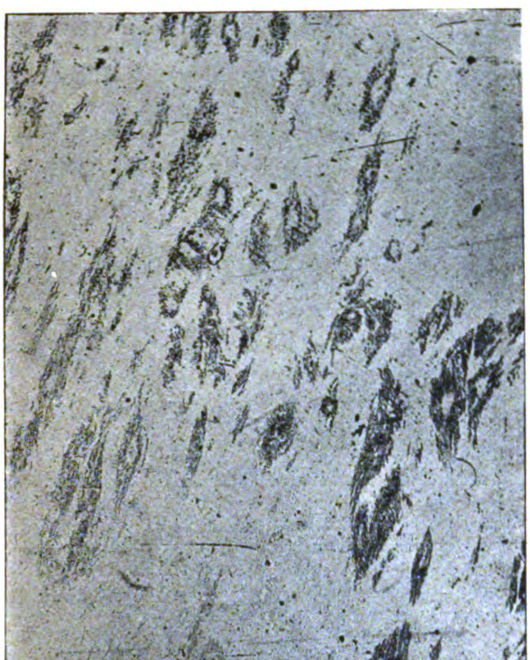

FIG. 1.—Punctate hæmorrhages in corpus callosum from a case of shell shock and burial; very probably accompanied by gas poisoning while lying unconscious and buried. Observe the small white area in the centre of the hæmorrhage, in the middle of which is a small vessel which, under a higher magnification, will be seen to contain a hyaline thrombus. (× 20.)

EXAMINATION OF THE BRAIN IN GAS POISONING.

I have recently had the opportunity of examining the brains of two cases of gas poisoning, in which gas was employed in an offensive by the enemy; and one is of special interest. The specimen is here, and you observe that the whole of the white

matter is peppered over with small dark spots about the size of a pin's head. These are due to hæmorrhages, but microscopic examination shows conditions which I have not found in CO poisoning, nor in other forms of gas poisoning; in fact, I have never seen any condition like this. The red blood corpuscles have been in large measure broken up, and the hæmoglobin converted into dark chocolate-coloured pigment granules, which fill the capillaries, arterioles and venules of the white matter of the brain. This is very possibly methæmoglobin, for it is known that exposure

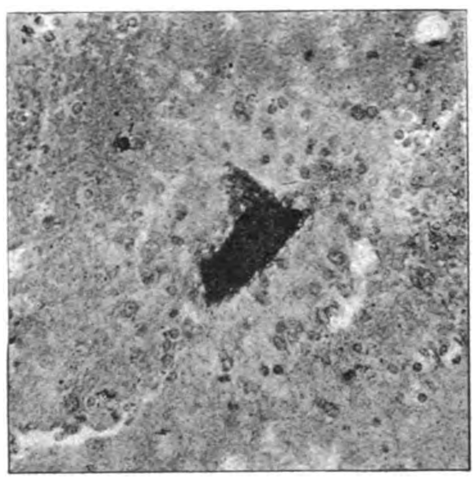

FIG. 2.—Hyaline thrombus of vessel in centre of punctate hæmorrhage. The thrombus was stained brown by dissolved pigment. Around the blocked vessel is a white area of brain substance containing numbers of leucocytes; outside this is the hæmorrhage, not very distinctly seen. The specimen was prepared from the subcortical white matter of the frontal lobe. (× 345.)

to nitrous fumes in concentration will oxidize the hæmoglobin, and convert it into methæmoglobin. Phosgene $COCl_2$ has been used by the Germans; it liberates HCl when it comes in contact with a moist surface, it is very irritating and would cause bronchiolitis, and I am informed by my friend, Professor Halliburton, that it is possible the free hydrochloric acid would convert the hæmoglobin into acid hæmatin.

Similar appearances were found to those described in CO poisoning, viz., multiple punctiform hæmorrhages in the white matter (photomicrograph 1), but the blood corpuscles were intermixed with chocolate-coloured pigment granules (photomicro-

graph 2). I will show by the epidiascope drawings illustrating the appearances presented. In the first you observe a vessel with a hyaline thrombus, stained pink by the fuchsin of the Van Gieson stain, but with a brownish tinge due to the change in the blood pigment. Possibly, as in capillary fat embolism, we may have embolism by these pigment granules, but, generally speaking, there is definite evidence of thrombus formation, with pigment granules in the thrombus.

In this drawing, you can observe also that the smallest vessels are filled with the pigment. Under a higher magnification, as the next drawing shows, the pigment can be seen in the vessels

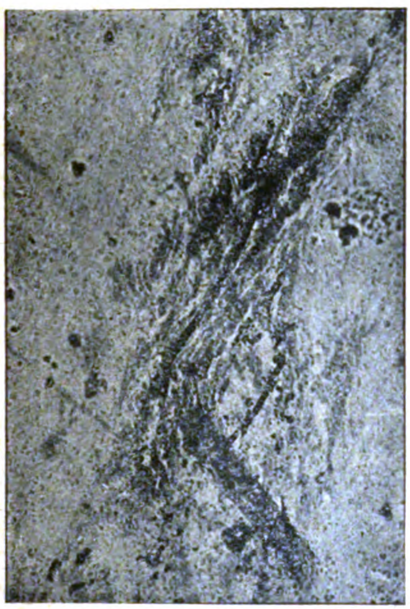

Fig. 3.—Small vessel breaking up into a leash of small arterioles compressed together by the hæmorrhage. The vessels are all blocked with black pigment granules. Specimen from internal capsule gas poisoning. (× 70.)

and in the circumscribed areas of hæmorrhage, as discrete granules packed together. The specimens show hyaline thrombus formation in the vessel contained in the centre of the hæmorrhage or passing to the centre of the hæmorrhage; the walls of these vessels are generally so thin as to support the view that they are veins. Some of the small vessels show aneurysmal dilatation. In the accompanying photomicrograph you can observe a leash of small arterioles

pressed together by the hæmorrhage at the side; on one there is an aneurism filled with pink-stained thrombus (photomicrograph 3). Amidst the corpuscles are numbers of pigment granules. The low power photomicrograph shows three hæmorrhages with occluded vessels proceeding to them (photomicrograph 4). Nearly all the punctiform hæmorrhages show a central vessel, surrounded by an area of necrosed brain tissue, infiltrated usually with leucocytes.

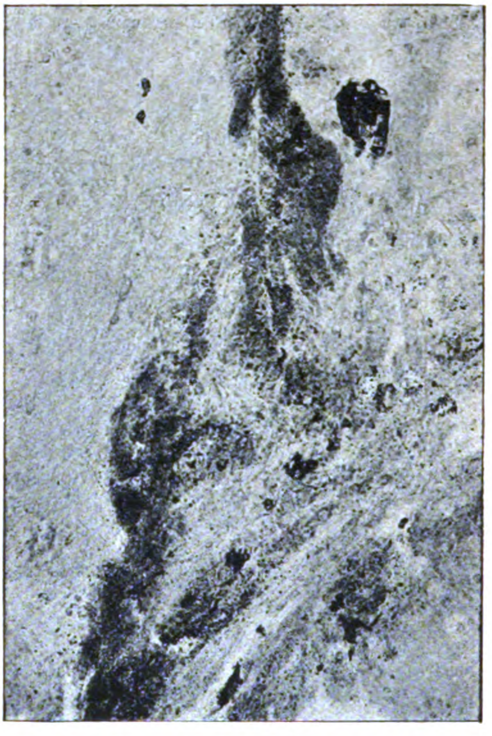

FIG. 4.—Leash of small perforating optostriate arteries filled with pigment granules. Two of the arterioles show miliary aneurysms. (× 350.)

The whole of this area is stained pink by Van Gieson stain, and it is more or less difficult to make out the wall of the central vessel. Sometimes a capillary filled with a thrombus can be seen running to the central vessel. It may be filled with chocolate-coloured pigment granules probably embedded in a coagulum, as in photomicrograph 2, or the coagulum may be of a pinkish-brown colour due to the coagulum being stained by the pigment dissolved in the

serum. In this, as in all other cases, there is evidence of an inflammatory stasis and excess of leucocytes in the vessels, and often into the perivascular sheath and tissues around.

FIG. 5.—Three punctate hæmorrhages showing optostriate arterioles filled with pigment granules. (× 30.)

CLINICAL NOTES OF THIS CASE.

Brain.—Surface veins, large and small, distended with dark blue clotted blood (veins of base of skull were in same condition). Section shows thickly scattered blue-black dots throughout the brain, especially in the white matter; this applies also to the cerebellum, and to much less extent to pons and medulla. No hæmorrhage seen. Patient was admitted ten hours after being gassed, and died sixty hours after admission from bronchiolitis and failure of right heart.

It is unfortunate that the clinical and post-mortem notes of this case are so scanty, for it is one of great pathological interest. The right heart failure and bronchiolitis, from which the patient died seventy hours after inhalation of the gas, would undoubtedly account for the venous congestion and stasis noted post mortem and for the thrombosis of the small vessels in the white matter of the brain. The blocking of the capillaries, small arteries and veins by the chocolate-

coloured granules of pigment, especially of the capillaries, would however suffice to account for the hæmorrhages. In some respects the capillary blockage by pigment resembles the condition found in pernicious malaria, in which disease Bignami and Nazari have described punctate hæmorrhage of the white matter of the brain; but I am inclined to believe the principal cause of the hæmorrhages is inflammatory stasis and hyaline thrombosis of arterioles, capillaries and venules, the pigment granules being incorporated in the coagulum.

I received the brain of another case in which the bruises on the body, the hæmatomata in the right lung, and the other conditions described, all suggest that he had been blown up by a shell and buried, and that the injuries of the brain were due to concussion. The fact that there was no CO detected in the blood does not conclusively prove that he was not exposed, while buried, to CO gas.

Clinical Notes of this Case.

Admitted with diagnosis of shell shock. Purple bruises on arm and leg of right side. Stertorous, unconscious and during the night before death constant fits. Lived thirty hours in hospital.

Post-mortem.—There were two hæmatomata in the right lung, but no other visceral injury. No hæmorrhage of the scalp and no fractures of the skull. Some slight subpial hæmorrhage of the right hemisphere. Fornix destroyed and full of hæmorrhages; hæmorrhages also seen in corpus callosum. Hæmorrhage in both optic thalami: cerebrospinal fluid tinged with blood. Men admitted with him said he had been buried by a shell. There was no CO in his blood, and the bruising was purple.

Microscopic Examination.—Multiple punctate hæmorrhages are seen; hyaline thrombosis of capillaries, arteries and venules; perivascular sheaths contain blood. Marked evidence of inflammatory stasis. Some of the small veins are filled with blood corpuscles, one half of which are polymorphonuclear leucocytes, and in the perivascular sheath and tissues around are large numbers of polymorph leucocytes.

Another case of which full notes were furnished was due to poisoning from a gas-shell barrage.

Notes.—A separate manuscript. Unfortunately there are no notes of the condition of the reflexes nor the state of tonus of the muscle of the limbs. The clinical notes do not indicate that this patient suffered with pneumonia, nor any obstruction to the entrance

of air to the lungs; there is no statement regarding the cause of the extremely rapid respiration but the fact that he was given oxygen and diffusible stimulant for the first twelve hours. Later there is a definite statement; there is no evidence of cyanosis and no respiratory obstruction. The oxygen was stopped; but the respiration still continued very rapid, 50 to 60.

After some days his condition greatly improved, and the respiration fell even to 28. Then on the last day, in the morning, he suddenly developed grave symptoms, and in the evening it is noted that he developed marked nystagmus, internal strabismus and right pupil was distinctly sluggish and slightly larger than the left. The conclusions and findings are not consistent with CO poisoning. I was unable to confirm the statement of hæmorrhage into the pons and medulla. The vessels were congested, but no hæmorrhage was found. The cerebral hemispheres were badly preserved, and I was only able to examine the cerebral cortex of the frontal lobes.

Microscopic Examination.—Portions of the frontal cortex and subjacent white matter showing to the naked eye miliary punctiform hæmorrhages were taken, and as in all the other cases blocked in paraffin, and sections cut and stained by Van Gieson and hæmatoxylin eosin methods, also with polychrome. The punctiform hæmorrhages appeared in some of the sections to form a circle of circumscribed, discrete, oval or round areas of extravasated blood, with often a section of a vessel in the centre or proceeding to the hæmorrhage area. In sections stained by the Van Gieson the lumen and the thin-walled vessels so seen appear a pale pink, and this is due to the contained hyaline thrombus.

In some vessels, red blood corpuscles are seen with abundant fibrin formation: a similar appearance to that seen in the alveoli in red hepatization; other vessels appear filled with polymorphonuclears and fibrin. Around the central thrombosed vessels of the hæmorrhage are seen deeply stained pink areas of necrosed brain tissue, infiltrated with polymorphonuclear leucocytes; very often a vessel can be seen filled with blood and extravasated into the sheath, and occasionally the rupture of a thin-walled vessel causing hæmorrhage into the perivascular sheath can be seen. This condition of central thrombosis with necrosis of brain tissue around, and infiltration of leucocytes, is similar to that observed in the CO poisoning from the nickel works, when the patient lived eight days, and is in accordance with what might be expected, seeing that the man lived six days after inhalation of the gas.

4

SUMMARY.

The reason why these punctiform hæmorrhages occur in the white matter of the brain is primarily due to the anatomical condition of the vessels in the white matter of the cerebrum, where the arteries are terminal; each small artery having a separate capillary system, likewise the emerging veins. A tendency to stasis may be brought about in these separate vascular systems by the failure of the heart as a force pump and suction pump, also by those respiratory conditions which lead to right heart dilatation, and interference with the return of blood from the skull. In the gas case, in which the hæmoglobin has been converted into pigment granules, it seems probable that the hæmorrhage may be accounted for by occlusion of the arteries. In most cases the two factors are combined. It seems probable, however, that either cause may act independently in causing inflammatory stasis and thrombosis, resulting in multiple punctiform hæmorrhages. It is unfortunate that with the exception of the case of CO poisoning by illuminating gas, I have not had the opportunity of examining the organs of the body.

It is quite probable that, as in that case, fatty degeneration of the heart, the kidneys, liver and vessels of the brain might be found to exist.

In conclusion, I desire to acknowledge my indebtedness to Miss Munro and Miss Watson for the assistance they have afforded me, and to the Board of Control for a grant to enable me to give them an honorarium for their services.

ON THE USE OF THE OPAQUE URETERAL CATHETER TO LOCALIZE MISSILES IN THE REGION OF THE KIDNEY AND URETER.

By ANDREW FULLERTON, M.D., M.Ch., F.R.C.S.I.

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It is highly important to be able to say whether a missile which has penetrated the body so as to lie somewhere in the renal region is actually in the kidney or is situated outside that organ. An aseptic missile may perhaps do no harm in the perirenal tissues, but a foreign body in the kidney itself, or near the ureter, ought to be removed. The kidney is liable to vary so much in position that the ordinary general rules that guide one in localizing a foreign body in a solid organ may fail, and much unnecessary trauma may be inflicted in the search for it. Hæmaturia may be due to a missile which simply contuses the kidney without entering it, or it may be due to a foreign body which lies in the organ, or has passed through it. We have found the depth of muscle between the kidney and the skin over the back to be greater in a soldier on active service than in an ordinary male of average size. This increased volume of muscle, due to hypertrophy from over use, places the kidney at a greater depth from the surface than usual, and renders the use of cross sections of an ordinary average body from an anatomical atlas of doubtful value.

Localization by X-rays has reached a high state of efficiency, but, as the case about to be mentioned shows, it can only give approximate results when a mobile organ like the kidney is under consideration. I have recently been using the opaque ureteral catheter combined with stereoscopic radiography to determine the position of a foreign body in the lumbar region relative to the kidney or ureter, with excellent results. The method is not attended with any great difficulty, and can be carried out, if necessary, without a general anæsthetic. A local anæsthetic to the urethra is desirable.

The observation is carried out as follows :—

An opaque ureteral catheter is passed into the pelvis of the kidney on the affected side. We know from experience of pyelography that it usually passes into the uppermost calyx (see fig. 3). The upper end of the catheter will probably be within ¾ to one

inch of the upper end of the kidney as the upper calyx is about that distance, as a rule, from the surface of the upper pole of the organ. The upper end of the catheter will form in this way a valuable landmark as regards the position of the kidney. Collargol may be injected to verify the assumption that the catheter is actually at the extreme upper limit of the pelvis, but this should not be done until the position of the foreign body relative to the catheter has been accurately ascertained, as the shadow of the collargol might obscure that of the foreign body.

Stereoscopic radiographs are taken with the catheter in position, and the antero-posterior relation of the foreign body to the opaque catheter noted. Captain Gamlin, R.A.M.C., has in several cases worked out these relative positions by Mackenzie Davidson's method, and I am indebted to him for his great care and skill in taking radiographs, and helping me in every way with these observations.

The following case will illustrate the method better than any descripton: Pte. No. 5525 was wounded with a rifle bullet while in the erect position, on March 15, 1916. The range of fire was not known, but as the bullet was slightly deformed at its apex it is probable that it had ricochetted before entering the patient's body. I am indebted to Captain Meyer for the following brief note taken at a casualty clearing station: The patient was hit in the right side, at 7.30 p.m., and was seen by Captain Meyer next morning at 5 o'clock. After being wounded he had a good deal of difficulty with his breathing. Blood was present in the urine. There was no vomiting. Patient's colour was "not bad." Pulse 93. Right side of abdomen rigid as far as umbilicus. Left side normal. Had a "cold" and a cough before he was wounded. Patient had some fever while at the casualty clearing station, the temperature reaching on one occasion 104° F.

When I saw him, a few days later, with Major West, R.A.M.C., at a base hospital, the hæmaturia had ceased, having lasted about three days, and his temperature was gradually settling. We found a small punctured wound 11½ centimetres above the highest point of the iliac crest on the right side, just behind the mid-axillary line, 15 centimetres from the mid-line of the body, and 5 centimetres behind the level of the anterior superior iliac spine. Worked out on cross sections, the bullet probably passed through the following structures—chest wall, pleural cavity (lower part), diaphragm, peritoneal cavity, liver, kidney.

On March 23 the urine was free from blood, pus and albumen.

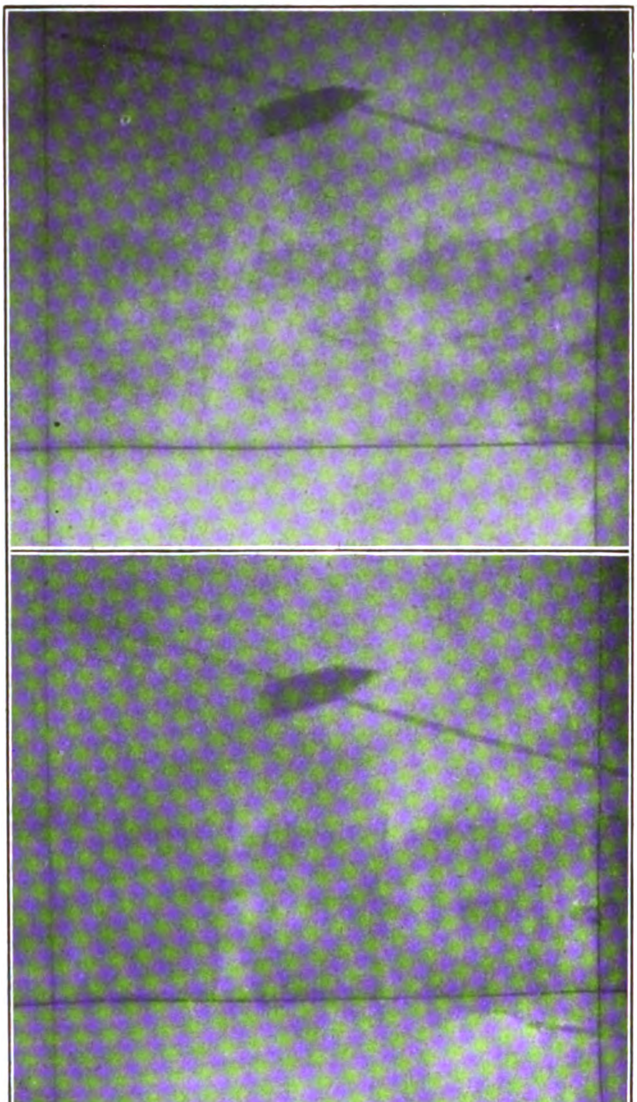

FIG. 1.—Stereoscopic skiagram, showing the position of the missile behind the ureteral catheter.

To illustrate "On the Use of the Opaque Ureteral Catheter to Localize Missiles in the Region of the Kidney and Ureter," by ANDREW FULLERTON, M.D., M.CH., F.R.C.S.I.

Specific gravity 1018. Reaction acid. On March 26 stereoscopic radiographs were taken by Captain Gamlin with the opaque catheter in position. At the same time urine was obtained from both ureters and found to be normal. The specific gravity was found to be equal on the two sides.

Captain Gamlin had previously radiographed the patient and had come to the conclusion that the bullet was in the right kidney, for two reasons. First, the bullet moved slightly with respiration, and second, the depth at which it was located, its distance from the middle line, and its level, corresponded with the position of the normal kidney (see figs. 1 and 2).

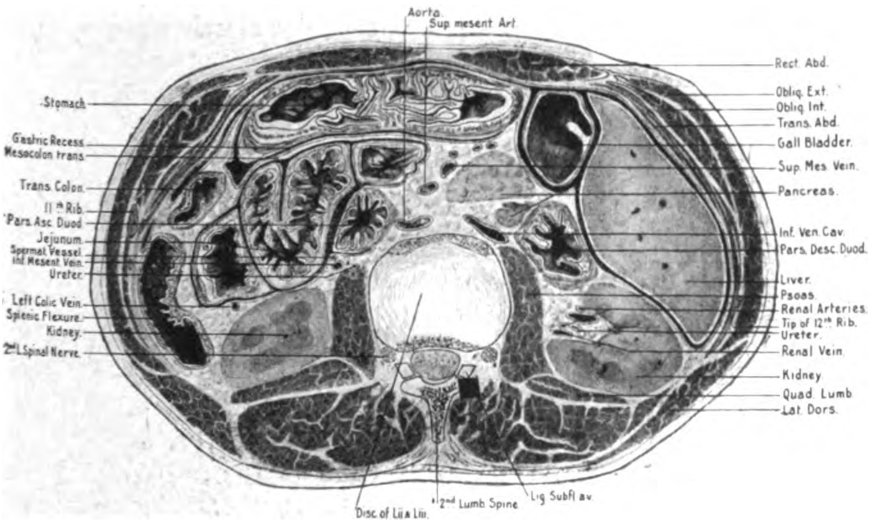

FIG. 2.—Transverse section of a male body at the level of the upper border of the third lumbar vertebra.

The following report was furnished by Captain Gamblin after radiographing with the opaque ureteral catheter in position :—

The distance of the centre of the anode from the plate which was on the patient's back was fifty-three centimetres and the shift of the tube was three centimetres on either side of the central line.

The stereoscopic radiographs (fig. 1) show that the catheter is in front of the bullet in its whole length.

Measurements of the shadows of bullet and catheter are as follows :—

1. *(a)* The distance of the centre of the base of the bullet from the centre of the spine is 5·6 centimetres. (*b*) The distance of the point of the bullet from the centre of the spine is 6 centimetres.

2. (*a*) The distance of the centre of the base of the bullet from the plate is 7·6 centimetres. (*b*) The distance of the catheter on a level with the base of the bullet from the plate is 9·4 centimetres. Therefore the base of the bullet is 1·8 centimetres behind the catheter. (*c*) The distance of the point of the bullet from the plate is 6·9 centimetres. (*d*) The distance of the catheter at the level of the point of the bullet from the plate is 10·5 centimetres. Therefore the apex of the bullet is 3·6 centimetres behind the catheter.

On referring to the radiogram it will be seen that the base of the bullet is on a line with the upper border of the third lumbar vertebra.

If a cross section of an average male body is taken at this level, and a point is marked on the right side 5·6 centimetres from the mid-line, and 7·6 centimetres from the surface (i.e., from the plate), it will be found to be in the kidney (see fig. 2). The measurements, however, of the distance of the base and apex of the bullet from the catheter prove that if the kidney is of normal thickness the bullet must be outside it. We may take it that the catheter is lodged about the central plane of the kidney. The normal kidney is about 3 centimetres (nearly $1\frac{1}{4}$ inches) thick. If the base of the bullet is 1·8 centimetres (nearly $\frac{3}{4}$ inch) behind the catheter it must therefore be about 3 millimetres ($\frac{1}{8}$ inch) behind the kidney, and the apex farther away still. Captain Gamlin estimated that the point of the catheter was $2\frac{1}{4}$ inches (5·7 centimetres) distant from the bullet, and, assuming that the point of the catheter is, say, $\frac{3}{4}$ to 1 inch from the upper surface of the upper pole of tne kidney, the bullet must be from 3 to $3\frac{1}{4}$ inches from the upper pole of the kidney. The kidney is $4\frac{1}{2}$ inches in length, therefore the bullet must be behind the kidney or ureter, at the level of the lower pole.

Operation on March 28 by Major West and myself discovered the bullet embedded in a large fleshy mass, composed of perirenal tissue, infiltrated with blood, and, possibly, urine. It was lying in a small abscess cavity just outside the kidney, on its posterior surface, at the level of the lower pole (see fig. 3). The bullet had passed through the kidney near the hilum from front to back. The movement on respiration noticed by Captain Gamlin was due to the fact that the large adherent mass of perirenal tissue in which the

bullet was lodged moved with the kidney on respiration. The kidney was pushed forward by this large mass, and thus the fallacy as to the position of the bullet, judged solely from its depth from the surface of the back, was easily explained.

We deemed it advisable to remove the bullet, though we were practically certain that it was well behind the kidney, on account of the patient's temperature, which was no doubt due to the small abscess cavity mentioned above.

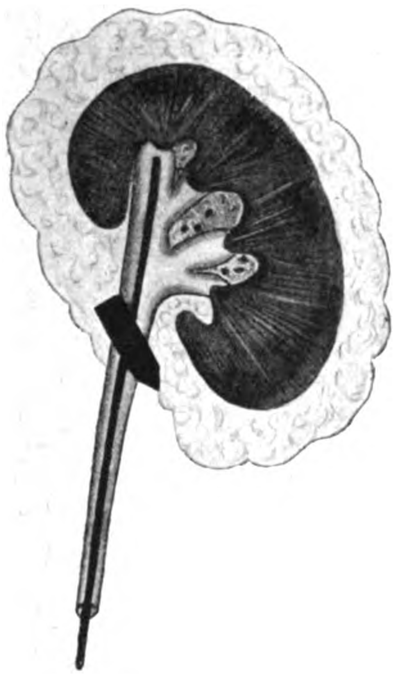

FIG. 3.—Semidiagrammatic section of a kidney showing a catheter passed into the upper calix, and its relation to the bullet. The infiltrated perirenal tissue is shown surrounding the kidney.

In a second case there were three shadows of shell fragments in the renal region. Two of these were obviously well behind the kidney, as seen by stereoscopic radiographs with the opaque catheter in position. The third was located by the method just described as lying at the inner margin of the upper pole of the kidney in the position of the suprarenal capsule. Post-mortem examination showed the fragment lying between the upper pole of the kidney and the suprarenal capsule. The missile had grooved the posterior

surface of the kidney and come to rest in the position indicated. I have full notes of this case, for which I am indebted to Captain Fitzmaurice Kelly, and there are other features in connexion with it which I hope to mention in a later communication on injuries to the kidneys. The case is mentioned here incidentally to illustrate the method of localization which I suggest may be of value in certain circumstances.

I am indebted to Miss Rea, of the Anatomical Department of Queen's University, Belfast, for the drawing of the kidney illustrating the position of the bullet relative to the ureteral catheter, and for the drawing of a cross section from the Anatomical Department of Queen's University, Belfast, by kind permission of Professor Symington.

SOME NOTES ON BILHARZIASIS.

By Major A. R. FERGUSON.
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Bilharziasis, although spread over a wide geographical area, is perhaps better studied in Egypt than elsewhere. Bilharzial infection in some degree exists in such a very considerable proportion of the male population of this country that the presence of our own troops here, where of necessity they must often be in close proximity to heavily infected native populations, makes the problem of direct military importance. Before dealing with the parasite or the manifestations of its presence in the human body, it will be of interest to note briefly some facts as regards its history and geographical distribution. There is evidence of its existence in specimens belonging to the Twelfth Dynasty, that is, from B.C. 4,000 to B.C. 2,500. This material, which exists in the British Museum, will, I hope, in more fortunate times than the present, yet become the subject of detailed investigation. Much later than this must be noted the discovery of the presence of eggs of the *Schistosomum hæmatobium* in an Egyptian mummy of the Twentieth Dynasty (B.C. 1,250 to B.C. 1,000), by Sir Armand Ruffer.[1]

Apart from these facts, the following considerations have always led me to believe that the baneful effects of this parasite not only existed but were widely recognized in the Nile Valley from the most ancient times. Remedies for the relief and cure of hæmaturia, for instance, are both numerous and frequently mentioned in the documentary fragments we possess of ancient Egyptian medicine.

Now, hæmaturia is such a common early manifestation of this disease in the bladder that it is only natural to infer that the remedies mentioned had been diligently sought for the relief of the bleeding from vesical bilharziasis. Again, calculus of the urinary bladder was probably quite as common amongst the innumerable dead of ancient Egypt as it is amongst the long-suffering "fellaheen" to-day, and this distressing malady, at least in this country, frequently follows chronic bilharziasis. The numerous armies which have passed in successive waves of invasion over Egypt must have contracted here and carried away with them the common

[1] *Brit. Med. Journ.*, January 1, 1910. Ruffer.

diseases of the Nile Delta. When we read, for example, in the Memoirs of Napoleon's surgeons, that amongst the medical problems which they had to face in order to maintain the fighting efficiency of his forces, hæmaturia and ophthalmia were amongst the most common, we have little difficulty in reaching the certain knowledge that bilharziasis to an undetermined extent undermined the strength of his troops. If we may reason backwards by analogy, one is tempted to ask to what distance may this same disease have been carried into the Farther East by the armies of Alexander the Great, who took some of his best fighting material from Egypt itself.

In view of the fact that some of us may yet be called upon to take medical charge of troops in various parts of our scattered Empire before the close of this stupendous War, I think it will not be out of place to give a brief review of the area over which the occurrence of bilharziasis is known. In this continent, whilst Egypt is appropriately termed its home, it occurs throughout Tripoli, Tunis, Algeria, Morocco, and from Suez right down the East Coast to the Cape of Good Hope. With the opening up of trade routes, it is known to have crept along the railway into Uganda; it has long existed in Abyssinia, it is present in some degree in most of the provinces of the Sudan, and finally, it has been recently noted both in the Zambesi basin and in the extensive area under the Protectorate of France around Lake Tchad. Of more particular importance is its presence amongst the desert Arabs both to the east and west of Egypt, whose use of the shallow surface wells of the smaller oases becomes significant from a military point of view. Farther beyond Egypt, to the east, it is known to exist amongst the lower classes at least in Syria, Arabia and Mesopotamia. It is probably too early, as yet, to expect its occurrence amongst those of our troops who have been invalided from the campaign in the Tigris valley. At least, I have searched for the ova of the parasite in as many as possible of those who have, on their return from Mesopotamia, found their way into a general hospital, without finding any evidence of their presence. It is met with in large tracts of country in China, but I must be content simply to mention its presence in at least five large provinces of the Yangtsekiang basin, and in at least four of the provinces of Japan, where, with characteristic thoroughness, Japanese medical officers have been instructed to look out for it. It is also found in Cyprus, Mauritius, and the West Indies, and even with the addition of these its geographical distribution is scarcely complete. As

troops are being accepted for service from many regions in which bilharziasis is endemic, it would be well to bear in mind that in a slight degree it may actually exist in men, for example, from the West Indies, who have been certified as fit for military service. If our colonial troops, serving on a much smaller scale in South Africa, were the means at that time of carrying the infection back with them to Australia and elsewhere, who shall say in what unexpected parts bilharziasis may, later on, manifest itself, when the massed armies of the Empire are again disseminated at the close of the War?[1]

I cannot enter upon any description of the changes produced by this worm in the body without first giving, as briefly as may be, an outline of the main phenomena in the interesting life cycle of the parasite. It is indeed fortunate that we are now in a position, thanks to the able researches conducted by Japanese parasitologists on the life-history of *S. japonicum*, and later by those of Lieutenant-Colonel Leiper, R.A.M.C., on *S. hæmatobium* in this country, to present a complete account of it. First then, the living ova which are voided in the urine or fæces of an infected person hatch out under the influences of warmth and contact with fresh water as very active ciliated miracidia. The life of these is limited—their period of greatest activity being the first eight or ten hours after emerging from the ovum. Whilst many undoubtedly perish, some find their way into a suitable mollusc, which so far have been found to be very numerous in the infected localities. Two species of mollusc, planorbis and bullinus, have been shown by Leiper to act as intermediary hosts of the two varieties of worms in Egypt. Infection of the mollusc, it will be gathered, takes place in considerably less than one day after the hatching out of the miracidium. An interesting intra-molluscal phase of development now takes place, into the details of which it is not necessary to enter. The result is, however, that after certain developmental changes, occupying from three to four weeks, elongated organisms having characteristic bifid tails (called cercariæ) are emitted from the intestinal canal of the mollusc in very large numbers. These cercariæ are the infecting phase of the parasite for man, and reasoning from the manner in which they appear to penetrate the skin of a young mouse, or other susceptible animal suspended in water containing them, we may infer that in man they penetrate

[1] An outbreak of rectal bilharziasis has occurred, since this paper was written, amongst the Australian troops quartered at Tel-el-Kebir.

those parts of his immersed body in which the skin is thinnest. Of course the possibility that the cercariæ may also enter the stomach with swallowed water is not to be excluded. These cercariæ resemble the adult worm in some respects. Like the latter, they possess two suckers—one oral sucker, terminal in position, and one ventral, by which they can securely attach themselves to any surface. Moreover they have no pharnyx at the commencement of the œsophagus—a feature which also differentiates the adult worm from the other distoma trematodes.

It is important to note that the life of cercariæ in water is limited, and that in order to develop into the mature worms, which they do without undergoing any further metamorphosis, they must reach the definitive host within forty-eight hours. Having once managed to effect an entry, they commence a long migratory journey in the body, and those which are fortunate enough to reach the liver are transformed in that organ into the sexually mature worms, male and female. So far as experiments hitherto conducted permit us to conclude, it would appear that the time which must elapse between the entry of the cercariæ and the detection of live ova in the urine and fæces of the animal infected is about two months, i.e., the transformation from cercariæ into adult worms which have taken up their abode in either bladder or rectum has occurred well within this period. It would appear, however, that in the case of man, this period covers three and a half to four months.

The characteristics of the adult worms are described in various accessible publications, so that I do not propose to do more here than lay stress on a few points of practical importance, having a bearing on the production of the pathological changes in man· Although the male worm would at first sight be judged to be cylindriform, it must be remembered that it is quite a flat, "leaf-like" worm, which appears cylindrical because the "leaf" is rolled on the axis of its midrib, so to speak, in such a fashion that the two lateral margins are either in close contact or more frequently overlap considerably. The worm, by this infolding of itself, is thus converted into a small tube in which the female is wrapped during the period of sexual life. The female is considerably longer than the male, and is of thin, hair-like, cylindrical appearance. Both sexes are provided with suckers, one of which is terminal, serves as a buccal cavity, and opens at once into a short straight œsophagus, while the other is ventral in position and serves either to fix the worm to a surface or as an aid to

locomotion. For the latter purpose it serves to secure the extended worm to a] fixed point towards which, as a *point d'appui*, the remainder of the worm then contracts. The external surface of the male worm is covered with numerous projecting bosses of minute size, and these doubtless aid in its intravenous movements. The youngest adult worms in the human body are found in the liver and vessels of the portal system. They travel to their permanent resting-places by way especially of the inferior mesenteric vein.

The course of events may be approximately stated to be as follows: As the worms attain sexual maturity, they make their way slowly into the main trunks of the portal vein. Arrived there, coupling of the sexes takes place, and the long, downward journey to the pelvis *against* the blood-stream is commenced. This only terminates in the minute venous radicles of the posterior vesical plexus and those of the descending colon and rectum. This pelvic voyage *against* the blood-stream must take a considerable time—it is difficult to say how long. It is probable, however, that it is entered upon by sexually immature worms, and that maturity is reached during its progress. Ova, more or less perfect in form and state of development of contents, are being cast off freely into the venous stream during the journey to the pelvis. These are carried back as passive particles to the liver, where they remain embedded in the tissue, undergoing slow degenerative changes and ultimate calcification.

It is, however, in the smaller veins in the situations already named in the depths of the pelvis that real deposition of ova begins, and it is the increasing multitudes of deposited ova imprisoned in the walls of the bladder and rectum which by their presence give rise to the inflammatory and other tissue changes which are the bases of the symptomatic manifestations. Dr. Looss, with whom I was associated for several years on the staff of the School of Medicine in Cairo, used to tell me that the manner of egg deposition by these worms was something like the following: The female, just prior to the act of depositing her ova, he believed, protruded herself beyond the gynæcophoric canal of the male as far as possible in a distal direction, that is, towards the true capillaries, and after depositing her ova, which were thus situated a short but appreciable distance beyond the actual situation of the male worm, withdrew her slender body into the shelter of that of the male worm. It is thus conceivable that if the coupled worms were impacted in a small vein just proximal to its subdivision into two, three or more branches, the female at successive periods of egg

deposition might reach with her extended body down each of these subdivisions in turn, so that the resulting groups of ova that emerged from the minute veins into the surrounding tissue spaces would have something of a fan-like distribution. Within a short time, at any rate, after the deposition of the eggs, they penetrate the vein wall, passing towards and through the mucous membrane of bladder or rectum as the case may be, in order to reach a free surface and, by means of one or other of the excreta, reach haply some fresh water, and thus recommence the cycle of changes by which the species is perpetuated.

These eggs probably possess very little inherent power of movement. Their progression towards the desired surface probably depends to a large extent on the muscular contraction of the wall of the viscus in which they are situated, aided to a certain extent by the piercing qualities of the sharp spine, terminal or lateral as the case may be, with which they are provided. As physicians we are directly concerned with the fate of and the changes set up by the presence in countless numbers of those ova which never reach the surface of bladder or bowel.

I must refer here to the results of a very large number of observations which I have made on the distribution of ova which often occur beyond these limited areas. During the course of a research on the nature and frequency of malignant disease occurring primarily in the urinary bladder and grafted on to bilharzial affections of that organ, I had occasion to examine microscopically small nodules of malignant tumour, the results of widespread dissemination from the primary site, and was struck with the presence of ova either in or in close proximity to such nodules in situations like remote lymphatic glands, the pericardium, the cardiac muscle, &c. It was therefore clear that ova, although largely laid, if the foregoing be true, within the limits of the portal circulation, could and did overstep these limits and pass over into the systemic vessels. This led me to examine, first of all, by means of injections of an alloy having a very low melting point, the freedom of the anastomotic communications between the portal and systemic venous system of the pelvis. Without entering into any description of the detailed anatomy, I became convinced that these were at once both larger and more numerous than most of the anatomical works have led us to suppose, and I cannot but think that in cases where, as in the natives of this country, severe bilharzial infections are the rule, the passage of ova in some degree into the systemic venous system, the settlement of a considerable

number in the lungs, and the distribution of the remainder by the arterial vessels, is a common, if not a regular occurrence.

I cannot state in detail here the results of my examination of the most varied organs and tissues in the body for the presence of ova. In many of these situations ova may exist in comparatively small numbers without inducing such pathological changes as would give rise to clinical symptoms, but special mention must be made of the results of their presence in the cerebrospinal nervous system. They may be found in comparatively small numbers in various parts of the brain, and more particularly in the meninges in a position corresponding to the position of the middle meningeal artery, though I cannot say that, beyond some thickening of the membranes, they have caused a distinct meningeal affection. It is quite otherwise, however, in the case of the spinal cord.[1] Certain cases of chronic bilharziasis occur in Egypt from time to time, in which definite but somewhat anomalous groups of symptoms referable to the lower part of the spinal cord make their appearance in the later stages of the malady. Sometimes these symptom-groups will imitate locomotor ataxia, and sometimes disseminated sclerosis. In such cases microscopical examination of the cord has revealed the presence of completely calcified ova surrounded by well-marked signs of neuroglial hypertrophy.

To one other possible fact of this more extended distribution of ova I should like to refer, and that is this. Although visible and apparent bilharziasis is not nearly so frequently met with in the female as in the male, the fact remains that examination, by special methods, of the uterus and ovaries of young girls in this country shows the occurrence of ova in these situations, sometimes in considerable numbers. Indeed, I have seen both ovaries so altered by a chronic oöphoritis, which could only be attributed to their presence, that I do not hesitate to conclude that this disease,

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[1] The outline of a typical case may be given as follows:—A male fellah, aged 35, had complained of numbness in the legs with increasing difficulty in walking for five months before admission to hospital. During the latter part of this period he had been quite confined to bed, unable to walk at all, and, on admission, sacral bedsores and trophic ulcers were present on the limbs. Clinically the disease, so far as it could be analysed during hospital residence, resembled disseminated sclerosis rather than locomotor ataxia. At post-mortem (February 18, 1912), he had a few signs, by no means pronounced, of old bilharziasis in the bladder, but examination of various parts of the body showed that in addition to the presence of eggs in the spinal cord, there had occurred a widespread distribution of them in various organs.

persisting from infancy, may be the cause of sterility in young married native women.

Some idea of the widespread prevalence of bilharziasis in Egypt may be gathered from the fact that, as based on the discovery of imprisoned ova in bladder, rectum, or other situations post mortem, I determined the existence of the disease, either in an extinct or active form, in no less than 60 per cent of 600 male subjects between the ages of 5 and 65 years of age. This series was examined consecutively, as the bodies came to the post-mortem room in the routine course of work.

Allusion has been made during the course of this paper to two varieties of ova, one possessing a terminal, the other a lateral spine. Helminthologists assure us that these ova belong to closely allied but distinct species of Schistosomidæ, and affirm the existence of certain anatomical differences in the worms which give rise to one or other variety of egg. Further, they state that the species of worm which gives rise to the lateral-spined ovum has a special predilection for the colon and rectum as its habitat in the body, whereas that from which the terminal-spined ovum is obtained attacks the bladder. This statement rests upon such facts as the following: In Martinique, for example, the intestinal form of the disease is said to exist alone, characterized by the presence of lateral-spined ova exclusively—the same statement being reported as true for other localities also. Apart from my own observations, however, which only apply to Egypt, and to which I shall allude later, I should like to mention that in Morocco,[1] in a group of five cases in which bilharzial ova were found in the fæces, only one showed ova possessing lateral spines.

In addition to this, French workers in the Lake Tchad[2] district, who examined the scholars of a village school, found that out of twenty cases in which ova were present in the urine, one case was characterized by the constant presence of lateral-spined ova, on repeated examination, whilst terminal-spined ova were present in the remaining nineteen.

My own observations in Egypt abundantly confirm these com-

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[1] "Note sur la Bilharziose au Maroc." Job. *Bull. et Mem. Soc. Méd. des Hôpit. de Paris*, 1915, December 30. Troisième Série. 31 ann., Nos. 39, 40, pp. 1282 to 1288.

[2] Bouilliez (Marc): "Les Bilharzioses dans le Moyen-Chari (Territoire du Tchad): Recherches experimentales," *Bull. Soc. Path. Exot.*, 1915, October 31, vol. viii, No. 8, pp. 604 to 610).

paratively few observations. As a result, I am of opinion that if the walls of bladder and rectum are treated by special maceration methods in dilute alkali, so that their entire calcified egg contents can be submitted to microscopical scrutiny, mixtures of the two varieties of egg will generally be found in both. It, however, remains true that in the case of the bladder terminal-spined ova largely predominate, though I cannot say the same in the case of the rectum, where frequently the two species seem to me to be sometimes fairly evenly mixed.

Even if our troops unfortunately contract, as to a certain extent they must, a bilharzial infection of rectum or bladder by bathing in or drinking the water of pools not only in Egypt and South East Africa, but also in the Tigris Valley, we may foretell with reasonable safety that the disease will never attain the terrible hold and produce the serious ravages which occur in heavily infected natives of Egypt.

At the worst I hope that, as in the case of the South African War, we may not have to look forward to more than an impaired state of health from this cause, which, after some considerable time (three to five years) may disappear altogether. The essential facts with regard to its mode of infection are now so well known that the necessary measures for its avoidance may be made precise, and should be stringently enforced, in the hope that military efficiency may not be impaired in the immediate future, and that the country may be saved the payment of large sums in compensation to men who need not have been infected. It is safe to say that once men of any unit are found to be reporting sick with symptoms such as slight suprapubic uneasiness and a desire to micturate more frequently than usual, if these symptoms are found to be related to the presence of bilharzial ova in the urine, more men in that unit than those complaining will certainly be affected. I found this to be the case some years ago in connexion with a certain regiment stationed at Kasr-el-Nil Barracks in Cairo, when Colonel (then Major) Fell, R.A.M.C., first reported its presence to me, and afterwards conducted a careful, systematic examination of the men.

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ON THE DIFFERENTIATION BY MEANS OF THE ABSORPTION OF AGGLUTININ TEST OF THE TYPES OF MENINGOCOCCI OBTAINED FROM THE CEREBROSPINAL FLUID OF CASES DURING THE CURRENT OUTBREAK OF CEREBROSPINAL FEVER.

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I.—Introduction.

Prior to the present epidemic of cerebrospinal fever, a considerable amount of work had been done with a view to differentiating the true meningococcus from the Gram-negative cocci that are frequently found in the nasopharyngeal secretion of normal persons. With this work the name of Lieberknecht (*Arch. für Hyg.*, 1909, vol. 68, p. 143) is especially associated, and this author showed conclusively that, by employing serological methods, the true meningococcus can be identified from these. This work was repeated and amplified by Elser and Huntoon (*Journal of Medical Research*, 1909, p. 377), who came to the same conclusion as Lieberknecht. The work of these investigators is completely recorded in their paper, and their serological investigations were fully controlled by cultural reactions. In general, they came to the conclusion that Gram-negative cocci, having the cultural and fermentative reactions of the meningococcus, are not necessarily that organism. Elser and Huntoon also imply, though they do not actually state, that the identification of the meningococcus by means of the agglutination and absorption of agglutinin tests is not always reliable.

It is to be noted that Elser and Huntoon called attention to the marked variability which the meningococcus exhibits in respect of its susceptibility to agglutination. They explain this as being dependent upon a variation of characters of the strains which were investigated, and, while suggesting that the true meningococcus might be, they failed to demonstrate satisfactorily that it was, really a group of organisms rather than a specific entity. While going far, therefore, to suggest that the term meningococcus was applied to a group of organisms they did not succeed in dividing that group into definite sub-groups or "types."

Their failure to indicate definitely the sub-divisions of the group may have depended to some extent upon the fact that the

sera, which these investigators used in their agglutination and absorption of agglutinin tests, were of very variable titre, so introducing possible errors of technique that are difficult of control.

The next advance in the examination of the question of the relationship which different strains of meningococcus bear to one another is due to Dopter and Pauron (*Comptes Rendus de la Société de Biologie*, June, 1914, p. 157) who, using the serum of specifically immunized horses for agglutinating the organisms, obtained from a number of cases of primary meningitis, showed that the Gram-negative diplococci producing this disease in man are divisible into a number of sub-groups. Dopter and Pauron referred to the type most frequently found as the true meningococcus, and the less frequently observed varieties they designated para-meningococci—α, β, γ—according to the manner in which they reacted in the presence of the sera employed for differentiating them.

Arkwright (*British Medical Journal*, December 18, 1915) and Ellis (*British Medical Journal*, December 18, 1915) both came to the conclusion that the meningococcus group of organisms was divisible into two sub-groups.

Neither of these authors describe, in the papers quoted, the results of absorption of agglutinin tests, and the technique of Ellis was such that positive agglutination due to group reaction could not be excluded owing to the high concentration of sera employed.

It is also to be noted that Arkwright failed to place, by means of the agglutination test, in either of the groups recognized by him, a number of the meningococci that he investigated.

To Lieutenant-Colonel Gordon is due the credit of having placed the whole question on a satisfactory basis. Defining as the meningococcus any Gram-negative diplococcus that caused primary meningitis, he proceeded to investigate the relations existing between the organisms—Gram-negative diplococci—obtained from the spinal fluids of cases that have occurred during the present epidemic of cerebrospinal fever.

By applying the agglutination, and absorption of agglutinin tests, to these organisms, he found that they were susceptible of classification into well-defined groups which he designated Type I, Type II, Type III, and Type IV meningococcus.

This paper is contributed as a continuation of the series of observations published by Gordon and Murray in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, October, 1915. Much new material has been obtained since the publication of this paper, and

unless the new material could be classified, as was that upon which the paper of Gordon and Murray was founded, the grouping of the meningococci would have to be reconsidered.

II.—Purpose of the Investigation.

It is of paramount importance to define the precise characters of the organisms causing epidemic meningitis. Precise definition alone will make serum therapy successful, will aid greatly in the administrative control of the disease, and may possibly indicate whether the clinical features of cases of the disease, due to the various types of the organism, can be correlated with the bacteriological findings, and serve as a guide for therapeutic measures and prognosis. The important bearing that the typing of a large number of meningococci has upon the therapeutics of the disease is self-evident, for, if we have an epidemic produced by a group of organisms, each member of that group should have its requisite antiserum, or a polyvalent serum should be prepared containing antibodies for all the types of the group. The ideal method of treating any given case of the disease serotherapeutically would be to administer the polyvalent serum in the first instance, when lumbar puncture is performed for diagnosis, and, as soon as the type of infecting coccus is known, further to treat by administration of the antiserum specific to and of proved potency for the infecting coccus. It would also be advisable to have the polyvalent serum particularly rich in antibodies corresponding to the types of cocci that are most commonly found infecting the meninges, and it is necessary to know the limits of the whole group in order that, in preparing the polyvalent serum, only pathogenic cocci be used.

In the same way the value of vaccine therapy is enhanced by a knowledge of the type of infecting organism, for without such knowledge the preparation of specific sensitized vaccines is precluded. As these have proved a valuable adjuvant to serum treatment, the type of organism obtained from a case should always be determined as soon as possible, with a view to the preparation of such vaccines, should their administration be deemed advisable.

In the administrative control of the disease it is equally necessary to investigate all the cocci obtained from the spinal fluid in cases of epidemic meningitis. Such investigation serves to demarcate the whole group of meningococci, and so permits of our drawing a clear distinction between true meningococci and the meningococcus-like organisms that are commonly found in the

nasopharynx, and which, for want of a better term, may be referred to as pseudo-meningococci. The importance of drawing a clear distinction between these and the true meningococci is considerable, for it frequently happens that a large number of men, amounting in some cases to over fifty per cent of the men examined, who are contacts of cases of meningitis, harbour these pseudo-meningococci in the nasopharynx, and would, were cultural examinations alone relied upon, be regarded as positive contacts, and so be unnecessarily retained in isolation.

The reliability of findings obtained by means of the agglutination, and the absorption of agglutinin tests applied to cerebrospinal strains of coccus, in investigating nasopharyngeal organisms, is shown by the fact that, of all the specimens of Gram-negative cocci isolated from the spinal fluid of cases that have occurred in the present epidemic, none failed to agglutinate with one or other of the four type-agglutinating sera. (It will be noted that in Diagrams VIII and IX certain organisms, provisionally classed as Type II on preliminary investigation, failed to agglutinate when being tested by the saturation method, showing that their agglutinability had altered. This occasionally happens when meningococci have been in culture for some months, and is of much more frequent occurrence in the case of Type II cocci than in that of the other types.) The majority of these qualified as Types I, II, III, or IV, when investigated by the absorption of agglutinin method.

It will be seen from the results obtained in the present investigation that, of the strains examined, the organisms described by Gordon as Types I, II, III, and IV meningococcus comprise all the organisms responsible for the cases of cerebrospinal fever in the present epidemic, with the exception of three, in which the organism could not definitely be typed, and three others, in which the investigation could not be completed owing to the organisms having died before the complete series of tests was applied to them. The subdivision of the group (meningococci) into the types mentioned is therefore fully justified.

III.—Technique.

Special attention is called to the fact that the technique employed in the present investigation was, as far as possible, standardized.

(*a*) Before saturation the organisms were provisionally typed by agglutination, the test being performed with all four type sera. Each serum was diluted 1 in 100, 1 in 200, and 1 in 400. The

number of cocci agglutinated was 1,000 million, and the reaction was carried out at 55° C. for twenty-four hours. In all the agglutination tests the volume of fluid in each tube was one cubic centimetre.

(*b*) The sera used were prepared by inoculating rabbits with specific strains of meningococci obtained from spinal fluids. The method of serum preparation employed was that described by Hine (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, October and December, 1915), and special care was taken to have the titre of the sera equal to 1 in 400 to 1 in 600 when tested with their homologous cocci.

(*c*) The emulsions used were standardized by the opacity method, and measured quantities of the standard emulsions were used at all stages of the investigation.

The time and temperature of incubation in each phase of the test were also standardized.

The following are the details of the method employed :—

(1) *Preparation of Emulsions.*—The growth of the organism, obtained by culture from the spinal fluid or nasopharynx, is subcultured for twenty-four hours on plates of legumin trypagar medium, containing no blood or other animal fluid. The growth is washed off in freshly made saline (about five cubic centimetres per plate) and the creamy emulsion so obtained is heated in a water bath at 65° C. for thirty minutes. The emulsion is then standardized, and sufficient saline is added to make the strength of the emulsion equal to 4,000 million per cubic centimetre. A five per cent solution of pure phenol is added in a volume equal to ten per cent of the total. Special care must be observed in the preparation of these emulsions; it is essential to use fresh saline and the phenol must be pure.

(2) *Absorption.*—In carrying out the absorption in the case of cocci provisionally placed in Types I, III and IV, the following method is used :—

Six centrifuge tubes—a, b, c, d, e, and f—are set up, and to each is added two cubic centimetres of 1 in 25 dilution of standard Type I serum. Then is added :—

(1) To "a," two cubic centimetres of emulsion of known Type I coccus—4,000 millions per cubic centimetre.

(2) To "b," two cubic centimetres of a similar emulsion of the organism to be investigated.

(3) To "c," two cubic centimetres of a similar emulsion of standard Type II coccus.

(4) To "d," two cubic centimetres of a similar emulsion of standard Type III coccus.

(5) To "e," two cubic centimetres of a similar emulsion of standard Type IV coccus.

(6) To "f," two cubic centimetres normal saline.

(The dilution of serum in each tube now equals 1 in 50.) The tubes are then incubated at 37° C. for twenty-four hours, and the degree of agglutination occurring in them is noted. The tubes are now centrifuged to clear as far as possible the supernatant fluids of a, b, c, d, and e; after which the contents of the centrifuge tubes are distributed into agglutination test tubes as in the following diagram which illustrates a rack prepared for carrying out the second phase of the absorption of agglutinin test.

	I				II				III				
	1 : 50	1 : 100	1 : 150	1 : 200	1 : 50	1 : 100	1 : 150	1 : 200	1 : 50	1 : 100	1 : 150	1 : 200	
1	o	o	o	o	o	o	o	o	o	o	o	o	a
2	o	o	o	o	o	o	o	o	o	o	o	o	b
3	o	o	o	o	o	o	o	o	o	o	o	o	c
4	o	o	o	o	o	o	o	o	o	o	o	o	d
5	o	o	o	o	o	o	o	o	o	o	o	o	e
—	w	x	y	z	w	x	y	z	w	x	y	z	—

The contents of tube "a" are distributed into the first tube of Sections II and III in volume of 0·5 cubic centimetre, then into the second tube of Sections II and III after dilution to 1 in 100, and in the same volume, and so into the third and fourth tubes in the requisite dilutions. The same is done with the supernatant fluids of tubes "b," "c," "d" and "e." The contents of tube "f" are distributed into the tubes to the left of the double ruled line (Section I), the first tube, i.e., left hand tube in each column, containing 0·5 cubic centimetre of 1 in 50, the second 0·5 cubic centimetre of 1 in 100, the third 0·5 cubic centimetre of 1 in 150, and the fourth 0·5 cubic centimetre of 1 in 200.

Designating the arrangement of the tubes from left to right as contained in Sections I, II and III, and from back to front as in rows 1, 2, 3, 4 and 5, and from left to right in each section as w, x, y, z, one adds to every tube of I 1, and III 1, 0·5 cubic

centimetre of a 2,000 million emulsion of standard Type I coccus.

To I 2 and III 2, 0·5 cubic centimetre of a similar emulsion of the organism to be investigated: to I 3 and III 3, 0·5 cubic centimetre of a similar emulsion of Type II; to I 4 and III 4, 0·5 cubic centimetre of a similar emulsion of Type III; to I 5 and III 5, 0·5 cubic centimetre of a similar emulsion of Type IV; to all tubes of II, 0·5 cubic centimetre of a similar emulsion of Type I is added. The dilution of the serum in each series of tubes w, x, y, z, is now equal to 1 in 100, 1 in 200, 1 in 300, 1 in 400. The tubes are then plugged with cotton wool and incubated for twenty-four hours at 55° C., and the results are read off. Section I informs us whether the organisms agglutinate in the presence of the unsaturated serum. Section II controls the saturation of the serum by the homologous, heterologous and test organisms, and Section III indicates the power that the organisms have of removing any group agglutinins that may be present.

In the diagrams illustrating the results obtained the following signs are used:—

+ + + designates complete agglutination, the supernatant fluid being quite limpid.

+ + almost complete sedimentation.

+ flocculi visible to the eye.

(+) flocculi demonstrable with a lens × 12.

o not noted.

The following is the protocol of an experiment carried out as described.

Organism under investigation—"Rob." Result of preliminary agglutination—55° C. twenty-four hours, standard 2,000 million emulsion in the presence of four type sera.

Serum I			Serum II			Serum III			Serum IV		
1 : 100	1 : 200	1 : 400	1 : 100	1 : 200	1 : 400	1 : 100	1 : 200	1 : 400	1 : 100	1 : 200	1 : 400
+++	+++	+++	—	—	—	+++	+++	+++	—	—	—

This result indicates that the organism under consideration is either a Type I or a Type III coccus.

Type I and Type III serum were therefore saturated with this organism, full controls being included in the experiment, and the following result was obtained:—

TYPE I SERUM.

Cocci	Unsaturated: Test coccus added 1/100	1/200	1/300	1/400	Saturated: Homologous coccus added 1/100	1/200	1/300	1/400	Saturated: Test coccus added 1/100	1/200	1/300	1/400
Type I, L. ..	+++	+++	+++	+++	–	–	–	–	–	–	–	–
? Type, Rob. ..	+++	+++	+++	+++	–	–	–	–	–	–	–	–
Type II, H. ..	–	–	–	–	+++	+++	+++	+++	–	–	–	–
„ III, C. ..	+	–	–	–	+++	+++	+++	+++	–	–	–	–
„ IV, E. ..	–	–	–	–	+++	+++	+++	+++	–	–	–	–

TYPE III SERUM.

Cocci	Unsaturated: Test coccus added 1/100	1/200	1/300	1/400	Saturated: Homologous coccus added 1/100	1/200	1/300	1/400	Saturated: Test coccus added 1/100	1/200	1/300	1/400
Type I, L. ..	++	–	–	–	+++	+++	+++	+++	–	–	–	–
? Type, Rob. ..	+++	+++	+++	++	+++	+++	+++	++	–	–	–	–
Type II, H. ..	–	–	–	–	+++	+++	+++	++	–	–	–	–
„ III, C. ..	+++	+++	+++	+++	–	–	–	–	–	–	–	–
„ IV, E. ..	–	–	–	–	+++	+++	+++	+++	–	–	–	–

This clearly shows that coccus "Rob" which, on preliminary agglutination gave equivocal results, is definitely a Type I coccus.

Results of the Absorption Test carried out by the Standard Method on Organisms Provisionally placed in Sub-group I on Preliminary Agglutination.

In the results tabulated (Table I), attention is called to the following cocci: 4 C., 6 Ex. A., 7 Ex. B., 15 Mack., 17 Nab., 21 Simp., 26 W., 29 Chil., 30 X., 31 Jon., and 38 Tho., all of which gave some reaction with Type I serum when first isolated. All the cocci tabulated clearly qualify as definite Type I organisms with the exception of these, which were, therefore, examined by the agglutination and absorption test in the presence of all four type sera. Some of them, notably 4 C., had in the interval been subcultured in fluid medium. The following results were obtained :—

TABLE I.—TYPE I. SERUM M.A.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
1 M. A. ..	o	+++	+++	+++	+++	—	—	—	—	—	—	—	—
2 Br. C.S.F.	o	+++	+++	+++	+++	—	—	—	—	—	—	—	—
3 Br. N. P.	o	+++	+++	++	+	—	—	—	—	—	—	—	—
4 C. ..	o	—	—	—	—	++	—	—	—	—	—	—	—
5 D. ..	o	+++	++	(+)	—	++	+	(+)	—	+	—	—	—
6 Ex. A. ..	o	+++	++	+	(+)	+++	+++	++	++	—	—	—	—
7 Ex. B. ..	—	(+)	—	—	—	+++	++	++	—	—	—	—	—
8 Fos. ..	o	+++	+++	++	++	—	—	—	—	—	—	—	—
9 Gr. A. ..	++	+++	++	+	—	—	—	—	—	—	—	—	—
10 Gr. B. ..	—	+++	+++	++	+	—	—	—	—	—	—	—	—
11 Hen. ..	o	+++	+++	(+)	—	—	—	—	—	—	—	—	—
12 Kn. ..	o	+++	++	++	++	—	—	—	—	(+)	—	—	—
13 Lam. ..	++	+++	+++	+++	(+)	—	—	—	—	—	—	—	—
14 Lit. A. ..	o	+++	++	++	++	—	—	—	—	—	—	—	—
15 Mack. ..	o	—	—	—	—	++	+	+	(+)	—	—	—	—
16 M. 2 ..	o	+++	+++	+++	+++	—	—	—	—	—	—	—	—
17 Nab. ..	o	(+)	—	—	—	+++	+++	+++	++	—	—	—	—
18 Nin. ..	++	+++	+++	+	—	—	—	—	—	—	—	—	—
19 R. ..	o	+++	+++	++	+	—	—	—	—	—	—	—	—
20 Sher. ..	o	++	++	++	++	—	—	—	—	(+)	—	—	—
21 Simp. ..	++	(+)	—	—	—	+++	+++	++	+	—	—	—	—
22 Win. ..	o	++	++	++	++	(+)	—	—	—	+	(+)	—	—
23 Cou. ..	o	+++	+++	+++	+++	—	—	—	—	—	—	—	—
24 Dim. ..	+++	+++	+++	+++	++	—	—	—	—	—	—	—	—
25 Bak. ..	+++	+++	+++	+++	+++	—	—	—	—	—	—	—	—
26 W. ..	++	+++	++	+	—	+++	+++	+++	++	—	—	—	—
27 Rob. ..	+++	+++	+++	+++	+++	—	—	—	—	—	—	—	—
28 Dic. ..	+++	+++	+++	+++	+++	—	—	—	—	—	—	—	—
29 Chil. ..	+	—	—	—	—	+++	+++	+++	+++	—	—	—	—
30 X. ..	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
31 J. ..	—	—	—	—	—	+++	+++	+++	++	—	—	—	—
32 Ay. ..	++	+++	++	+	(+)	—	—	—	—	—	—	—	—
33 Ho. ..	+++	+++	+++	+++	+	—	—	—	—	—	—	—	—
34 Bar. ..	++	+++	+++	+	—	—	—	—	—	—	—	—	—
35 Car. ..	+++	+++	+++	+++	++	—	—	—	—	—	—	—	—
36 Wil. ..	+++	+++	+++	+++	+	—	—	—	—	—	—	—	—
37 Les. B.	++	+++	++	++	(+)	+	(+)	—	—	—	—	—	—
38 Tho. ..	(+)	—	—	—	—	+++	+++	+	(+)	—	—	—	—
39 Col. ..	+++	+++	+++	+++	(+)	—	—	—	—	—	—	—	—
40 Jen. 1 ..	o	+++	+++	++	+	—	—	—	—	—	—	—	—
41 Jen. 2 ..	o	+++	+++	++	+	—	—	—	—	—	—	—	—
42 Control, Type II	—	—	—	—	—	+++	+++	+++	++	—	—	—	—
43 Control, Type III	—	—	—	—	—	+++	+++	+++	++	—	—	—	—
44 Control, Type IV	—	—	—	—	—	+++	+++	+++	++	—	—	—	—
45 Duf. ..	o	+++	+++	+++	+++	—	—	—	—	—	—	—	—

TABLE II.

Type I Serum.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
4 C.	+++	+++	+++	+++	—	++	+	—	—	—	—	—	—
6 Ex. A. ..	++	+++	++	+	—	+++	+++	+++	+++	—	—	—	—
7 Ex. B. ..	++	+++	++	+	—	+++	+++	+++	+++	—	—	—	—
15 Mack. ..	o	—	—	—	—	++	++	+	(+)	—	—	—	—
17 Nab. ..	o	++	—	—	—	+++	+++	+++	++	—	—	—	—
21 Simp. ..	+++	+++	++	+	—	+++	+++	+++	+++	—	—	—	—
26 W.	+++	+++	++	+	—	+++	+++	+++	++	—	—	—	—
29 Chil. ..	++	+++	—	—	—	+++	+++	+++	+++	—	—	—	—
30 X.	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
31 J.	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
38 Tho... ..	+++	+++	++	+	—	+++	+++	+++	+++	—	—	—	—
Control Type I	+++	+++	+++	+++	+++	—	—	—	—	—	—	—	—
" " II	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
" " III	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
" " IV	+++	—	—	—	—	+++	+++	+++	+++	—	—	—	—

Type II Serum.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
4 C.	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
6 Ex. A. ..	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
7 Ex. B. ..	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
15 Mack. ..	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
17 Nab. ..	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
21 Simp. ..	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
26 W.	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
29 Chil. ..	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
30 X.	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
31 J.	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
38 Tho... ..	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
Control Type I	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
" " II	+++	+++	+++	+++	+++	—	—	—	—	—	—	—	—
" " III	—	—	—	—	—	+++	+++	+++	+++	—	—	—	—
" " IV	++	+	—	—	—	+++	+++	+++	+++	—	—	—	—

TYPE III SERUM.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated — Test coccus added				Saturated — Homologous coccus added				Saturated — Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
4 C.	+	+	–	–	–	+++	+++	+++	++	–	–	–	–
6 Ex. A. ..	–	–	–	–	–	+++	+++	+++	+	–	–	–	–
7 Ex. B. ..	–	–	–	–	–	+++	+++	+++	+	–	–	–	–
15 Mack. ..	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
17 Nab. ..	–	–	–	–	–	+++	+++	+++	+	–	–	–	–
21 Simp. ..	++	+++	+	–	–	+++	+++	+++	++	–	–	–	–
26 W.	+++	+++	+++	+	–	+++	++	(+)	–	–	–	–	–
29 Chil. ...	+++	+++	+++	+++	+++	–	–	–	–	+	–	–	–
30 X.	+++	+++	+++	+++	++	+++	–	–	–	–	–	–	–
31 J.	+++	+++	+++	+++	++	–	–	–	–	–	–	–	–
38 Tho... ..	++	+++	+	–	–	+++	+++	++	+	–	–	–	–
Control Type I	++	+++	++	+	–	+++	+++	+++	+	–	–	–	–
,, ,, II	–	–	–	–	–	+++	+++	+++	+	–	–	–	–
,, ,, III	+++	+++	+++	+++	++	+	–	–	–	–	–	–	–
,, ,, IV	–	–	–	–	–	+++	+++	+++	++	–	–	–	–

TYPE IV SERUM.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated — Test coccus added				Saturated — Homologous coccus added				Saturated — Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
4 C.	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
6 Ex. A. ..	(+)	+++	+++	++	+	++	(+)	(+)	(+)	++	+	–	–
7 Ex. B. ..	+	+++	+++	+++	+++	–	–	–	–	++	–	–	–
15 Mack. ..	–	–	–	–	–	+++	+++	+++	++	–	–	–	–
17 Nab. ..	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
21 Simp. ..	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
26 W.	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
29 Chil. ..	–	–	–	–	–	+++	+++	+++	+	–	–	–	–
30 X.	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
31 J.	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
38 Tho... ..	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
Control Type I	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
,, ,, II	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
,, ,, III	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
,, ,, IV	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–

This result shows that a considerable number—four out of eleven—of the cocci which were provisionally placed in the Type I sub-group on preliminary agglutination, and which failed, after

cultivation over prolonged periods, to react with Type I serum, on further investigation qualified as Type III cocci.

One—26 W.—also probably belongs to this group although it fails to absorb completely the Type III agglutinin when tested by the standard method. Two—6 Ex. A. and 7 Ex. B.—appear to be Type IV organisms. It is to be noted that the organisms which cannot be placed definitely in any one group are few in number. Those already indicated, viz., 17 Nab., 21 Simp. and 38 Tho., comprise all but three of those that have been obtained from cases in the present epidemic and failed to qualify as members of one or other of Gordon's types. It is to be specially noted that none have failed to agglutinate with one or more of the type sera, if tested soon after isolation and by the standard method.

An attempt was made to determine whether these unplaceable organisms form a group by themselves. Specific sera were prepared by inoculating rabbits with each of them, each serum being then saturated with the unplaceable cocci and control cocci. The relation of these to one another and to the four types will be considered later (see Section VIII).

From the above results (Tables I and II) the following conclusions seem permissible :—

(*a*) The majority of cocci obtained from the spinal fluid, which are provisionally placed in Type I sub-group, definitely qualify as Type I organisms when examined by the absorption test.

(*b*) As a number of the cocci provisionally classed as being Type I subsequently qualify as Type III cocci, there is a group relationship between Types I and III.

(*c*) A similar relationship but of much less marked degree occasionally is found between Types I and IV.

IV.—Absorption of Type III Serum with Organisms Provisionally Classed as Type III Cocci on Preliminary Agglutination.

The results obtained are quite comparable with those obtained in the case of Type I cocci, and permit of similar conclusions being drawn.

To the number of cocci above, which definitely qualify as Type III organisms, must be added those which are indicated on Table II as also being Type III organisms. Three other organisms also appear to belong to this group as will be seen on further examination (see Table VI).

TABLE III.

TYPE III SERUM.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
(*a*) P.	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
(*b*) B.	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
(*c*) C.	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
(*d*) W.	–	–	+++	+++	+++	–	–	–	–	–	–	–	–
(*e*) R.	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
(*f*) Bow. ..	++	+++	+++	++	+	+++	+++	++	++	–	–	–	–
(*g*) Br. F. ..	++	+++	+++	++	+	+++	+++	(+)	(+)	+	+	–	–
(*h*) Cr.	+++	+++	+++	++	+	+++	+++	++	+	–	–	–	–
(*i*) Y.	+	+++	+	–	–	+++	+++	++	++	–	–	–	–
(*j*) Pon. ..	+++	+++	++	+	–	+++	+++	+++	+++	–	–	–	–
Control, Type I	+++	+++	+++	++	++	+++	+++	+++	+++	–	–	–	–
,, ,, II	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
,, ,, III	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
,, ,, IV	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–

TABLE IV.

TYPE IV SERUM.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
1′ Ban.	++	+++	+++	+++	++	–	–	–	–	–	–	–	–
2′ Gar.	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
3′ My. 23 ..	++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
4′ My.	++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
5′ Hi.	++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
6′ P. (knee) ..	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
7′ Bat.	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
8′ Wigg	–	+++	++	+	–	(+)	–	–	–	–	–	–	–
9′ Ed.	+++	+++	+++	+++	++	–	–	–	–	–	–	–	–
10′ N.	–	+++	+++	++	(+)	++	(+)	–	–	–	–	–	–
11′ Gar. (N.P.) ..	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
12′ P. 5	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
13′ H.	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
14′ Nev. ..	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
Control, Type I	+	–	–	–	–	+++	+++	+++	++	–	–	–	–
,, ,, II	–	–	–	–	–	+++	+++	+++	++	–	–	–	–
,, ,, III	–	–	–	–	–	+++	+++	+++	++	–	–	–	–
,, ,, IV	++	+++	+++	+++	++	–	–	–	–	–	–	–	–

Here, again, there remain a few cocci which, while agglutinating with Type III serum, fail to qualify as members of that group on application of the absorption test (see Section VI).

V.—Absorption by Organisms Provisionally Classed as Type IV Cocci on Preliminary Agglutination.

Table IV. illustrates the results obtained :—

The results above call for no comment, being clear-cut.

VI.

Saturation of all four type sera with those organisms which failed to qualify as Type III or IV, although provisionally placed in one or other of these groups on preliminary agglutination.

TABLE V.

Type I Serum.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
2' Gar... ..	+++	−	−	−	−	+++	+++	+++	+	−	−	−	−
11' ,, ...	+++	−	−	−	−	+++	+++	+++	+	−	−	−	−
(*g*) Br. F. ..	(+)	+	(+)	−	−	+++	+++	+++	+++	−	−	−	−
(*f*) Bow. ..	(+)	−	−	−	−	+++	+++	+++	++	−	−	−	−
(*h*) Cr.	+++	−	−	−	−	+++	+++	+++	+++	−	−	−	−
(*i*) Y.	−	−	−	−	−	+++	+++	+++	+++	−	−	−	−
(*j*) Pon. ..	++	−	−	−	−	+++	+++	+++	+++	−	−	−	−
Control, Type I	+++	+++	+++	+++	+++	−	−	−	−	−	−	−	−
,, ,, II	−	−	−	−	−	+++	+++	+++	+++	−	−	−	−
,, ,, III	(+)	(+)	−	−	−	+++	+++	+++	+++	−	−	−	−
,, ,, IV	+++	−	−	−	−	+++	+++	+++	+++	−	−	−	−

Type II Serum.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
2' Gar... ..	−	−	−	−	−	+++	+++	+++	+++	−	−	−	−
11' ,, ...	−	−	−	−	−	+++	+++	+++	+++	−	−	−	−
(*g*) Br. F. ..	(+)	−	−	−	−	+++	+++	+++	+++	−	−	−	−
(*f*) Bow. ..	−	−	−	−	−	+++	+++	+++	+++	−	−	−	−
(*h*) Cr.	++	−	−	−	−	+++	+++	+++	+++	−	−	−	−
(*i*) Y.	−	−	−	−	−	+++	+++	+++	+++	−	−	−	−
(*j*) Pon. ..	+	−	−	−	−	+++	+++	+++	+++	−	−	−	−
Control, Type I	−	−	−	−	−	+++	+++	+++	+++	−	−	−	−
,, ,, II	+++	+++	+++	+++	+++	−	−	−	−	−	−	−	−
,, ,, III	−	−	−	−	−	+++	+++	+++	+++	−	−	−	−
,, ,, IV	++	+	−	−	−	+++	+++	+++	+++	−	−	−	−

TYPE III SERUM.

	Agglut. 1/50 for 24 hrs. at 37° C.	Unsaturated — Test coccus added				Saturated — Homologous coccus added				Saturated — Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
2′ Gar... ..	++	–	–	–	–	+++	+++	+++	+++	–	–	–	–
11′ ,, ...	+++	+++	+++	++	+	+++	+++	+++	+++	–	–	–	–
(*g*) Br. F. ..	++	+++	+++	++	+	+++	+++	(+)	(+)	+	+	–	–
(*f*) Bow. ..	++	+++	+++	++	+	+++	+++	+++	++	–	–	–	–
(*h*) Cr.	+++	+++	+++	+++	++	+++	+++	+++	++	–	–	–	–
(*i*) Y.	–	+	–	–	–	+++	+++	+++	+	–	–	–	–
(*j*) Pon. ..	+++	+++	++	+	–	+++	+++	+++	++	–	–	–	–
Control, Type I	+++	+++	+++	+++	++	+++	+++	+++	++	–	–	–	–
,, ,, II	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
,, ,, III	+++	+++	+++	+++	++	–	–	–	–	–	–	–	–
,, ,, IV	–	–	–	–	–	+++	+++	+++	++	–	–	–	–

TYPE IV SERUM.

	Agglut. 1/50 for 24 hrs. at 37° C.	Unsaturated — Test coccus added				Saturated — Homologous coccus added				Saturated — Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
2′ Gar... ..	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
11′ ,, ...	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–
(*g*) Br. F. ..	–	–	–	–	–	+++	+++	+++	++	–	–	–	–
(*f*) Bow. ..	–	+++	++	++	+	(+)	–	–	–	–	–	–	–
(*h*) Cr.	–	–	–	–	–	+++	+++	+++	++	–	–	–	–
(*i*) Y.	–	–	–	–	–	+++	+++	+++	++	–	–	–	–
(*j*) Pon. ..	+	–	–	–	–	+++	+++	+++	+++	–	–	–	–
Control, Type I	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
,, ,, II	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
,, ,, III	–	–	–	–	–	+++	+++	+++	+++	–	–	–	–
,, ,, IV	+++	+++	+++	+++	+++	–	–	–	–	–	–	–	–

The above results show that (*f*) Bow., which was provisionally placed in Group III really belonged to Group IV, while (*g*) Br. F. is probably a Type III coccus whose power of saturating agglutinins from serum is low and the coccus shows a degree of auto-agglutination.

The cocci 11′ Gar. and 2′ Gar., cerebrospinal and naso-pharyngeal cocci from the same case, are included in the above table to illustrate the less specific qualities of the latter; a feature that is not uncommon, and emphasizes the necessity of employing cerebrospinal strains of meningococci for preparing agglutinating sera.

VII.—Investigation of those Organisms which were Provisionally Classed as Types I, III, IV Cocci on Preliminary Agglutination, and which, on Absorption and using the Standard Technique, failed to qualify as Members of any of the four Recognized Groups of Meningococci.

There remain, therefore, (*h*) Cr., (*i*) Y. and (*j*) Pon. (Table V), together with 17 Nab., 21 Simp., and 38 Tho. (Table II), which have not been classified. These are the only cocci that have failed to qualify definitely in my hands, when complete investigation was possible, as members of one or other of the four types of meningococci recognized by Gordon.

I therefore proceeded to investigate these by preparing agglutinating sera specific to each of them. Each of the sera was then saturated with emulsions of the other unclassified cocci and with standard type cocci for control; the standard technique was employed.

Table VI shows the results obtained using serum specific to coccus 21 Simp.

TABLE VI.—Serum *v.* Coccus, Simp. 21.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
17 Nab. ..	+	+	—	—	—	+++	++	++	+	+	—	—	—
21 Simp. ..	++	+++	+++	++	+	+++	++	—	—	+++	++	—	—
38 Tho... ..	++	+++	+++	+	(+)	++	—	—	—	—	—	—	—
(*g*) Br. F. ..	+	+++	+++	++	+	++	+	—	—	+++	++	(+)	(+)
(*h*) Cr.	++	+++	++	+	+	—	—	—	—	—	—	—	—
(*i*) Y.	—	—	—	—	—	+++	++	+	(+)	—	—	—	—
(*j*) Pon. ..	+	+++	++	—	—	+++	++	+	+	++	—	—	—
Control I ..	+	+++	++	+	—	+++	++	+	+	+	—	—	—
,, II ..	—	—	—	—	—	+++	++	++	+	—	—	—	—
,, III ..	++	+++	+++	++	+	++	+	—	—	—	—	—	—
,, IV ..	—	—	—	—	—	+++	++	++	+	—	—	—	—

These results show that 21 Simp., 38 Tho., (*g*) Br. F., and (*h*) Cr., are closely related to one another, while the control with Type III coccus indicates that these organisms are very closely related to Type III. They may, I think, justifiably be considered as members of that group.

Table VI A shows that none of the organisms can be placed in the same group as 17 Nab. Which must therefore be regarded as an aberrant organism, as also must (*i*) Y and (*j*) Pon.

TABLE VIa.—Serum *v.* Coccus, 17 Nab.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
17 Nab	+	++	+	–	–	–	–	–	–	–	–	–	–
21 Simp. ..	–	–	–	–	–	++	+	–	–	–	–	–	–
38 Tho.	–	–	–	–	–	++	+	–	–	–	–	–	–
(*g*) Br. F. ..	++	++	++	++	+	++	+	–	–	++	++	++	+
(*h*) Cr.	+	++	++	+	–	++	+	–	–	–	–	–	–
(*i*) Y.	–	–	–	–	–	++	+	–	–	–	–	–	–
(*j*) Pon... ..	–	–	–	–	–	++	+	–	–	–	–	–	–
Control I ..	–	–	–	–	–	++	+	–	–	–	–	–	–
,, II ..	–	–	–	–	–	++	+	–	–	–	–	–	–
,, III ..	(+)	+	–	–	–	++	+	–	–	–	–	–	–
,, IV ..	–	–	–	–	–	++	+	–	–	–	–	–	–

VIII.—Absorption with Cocci Provisionally Classed as Type II on Preliminary Agglutination.

In the case of sub-group II the results obtained by the standard saturation method are not so definite as in the case of I, III, and IV. The technique has therefore to be controlled with special care, and experience has shown that a modification of the standard method previously described gives more satisfactory results than the routine procedure. The organisms of this sub-group are more difficult to handle than are Types I, III and IV. They die more readily than do these organisms and it is frequently difficult to prepare Type II agglutinating serum. The sera, too, are less stable than those prepared with the other types. Further, some specimens of Type II appear to undergo some change—possibly of an autolytic nature—that render their emulsions uncertain in their susceptibility to agglutination. These factors make the task of applying the absorption test to the investigation of Type II cocci one of peculiar difficulty.

The following modification of technique has been found necessary in the investigation of this sub-group.

(1) Emulsions are made in the same way as for the standard technique, but are standardized to contain 8,000 million cocci per cubic centimetre.

(2) The saturation is conducted in two phases. The serum dilution 1 in 25 has added to it one cubic centimetre of the 8,000 million emulsion, and saturation is allowed to proceed for twenty-four hours at 37° C. when one cubic centimetre of a 4,000 million emulsion is added, and the tubes again incubated for twenty-four

hours. Thereafter the technique is exactly the same as that described for the investigation of Types I, III, and IV.

Employing this technique and using "serum H," a serum prepared from a spinal strain that agglutinated well, the following results were obtained in the investigation of those organisms which, on preliminary examination, were classed provisionally as Type II cocci.

TABLE VII.

TYPE II. SERUM H.

	Agglut. 1/50 for 24 hrs. at 37° C.	UNSATURATED				SATURATED				SATURATED			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
(i) A. ..	—	++	+	—	—	—	—	—	—	—	—	—	—
(ii) M. ..	—	+++	+++	+++	(+)	+	—	—	—	—	—	—	—
(iii) Cl. ..	—	+	+	—	—	—	—	—	—	—	—	—	—
(iv) Ja. ..	++	+++	+++	+++	(+)	+++	+++	+++	++	—	—	—	—
(v) D. ..	—	+++	(+)	—	—	+++	+++	+++	++	—	—	—	—
(vi) Mo. ..	—	+++	+	—	—	++	—	—	—	—	—	—	—
(vii) Hu. ..	++	+++	++	(+)	—	++	(+)	—	—	—	—	—	—
(viii) Hug. ..	++	+++	++	(+)	—	+++	+++	+++	++	—	—	—	—
(ix) W. ..	—	+++	++	—	—	++	++	—	—	—	—	—	—
(x) St. (N.P.) ..	++	+++	+++	++	+	+++	++	—	—	—	—	—	—
(xi) Sh. ..	++	+++	+++	+++	++	++	(+)	—	—	—	—	—	—
(xii) Gr. ..	—	—	—	—	—	+++	+++	+++	(+)	—	—	—	—
(xiii) Gl. ..	—	+++	+++	++	+	++	(+)	—	—	—	—	—	—
(xiv) Mi. ..	—	++	(+)	—	—	++	++	—	—	—	—	—	—
(xv) Gi. ..	—	++	—	—	—	++	(+)	—	—	—	—	—	—
(xvi) F. ..	+	—	—	—	—	+	—	—	—	—	—	—	—
(xvii) Br. ..	—	++	+	—	—	++	+	(+)	—	—	—	—	—
(xviii) Eng. ..	+	—	—	—	—	+++	+++	+	(+)	—	—	—	—
(xix) Co. ..	+	+	(+)	—	—	+	+	—	—	—	—	—	—
(xx) Pal. ..	—	+	—	—	—	++	++	—	—	—	—	—	—
(xxi) Win. ..	—	++	+	—	—	+++	+++	++	+	—	—	—	—
(xxii) McP. ..	+	+++	+++	+++	++	+++	+++	+++	++	+++	+++	+++	++
(xxiii) C. ..	—	—	—	—	—	+++	+++	+++	++	—	—	—	—
(xxiv) Bar. ..	—	—	—	—	—	++	++	—	—	—	—	—	—
(xxv) B.D. ..	—	++	+	—	—	—	—	—	—	—	—	—	—
(xxvi) Ou. ..	+	+++	++	+	—	+++	+++	++	(+)	—	—	—	—
(xxvii) Pla. ..	—	+	—	—	—	—	—	—	—	—	—	—	—
(xxviii) St. (C.S.F.)	++	+++	+++	++	+	++	++	—	—	—	—	—	—
(xxix) New. ..	++	+++	+++	++	+	—	—	—	—	—	—	—	—
(xxx) Frs. ..	++	+++	+++	++	+	++	(+)	—	—	—	—	—	—
(xxxi) Wy. ..	(+)	++	++	—	—	+++	+++	++	+	—	—	—	—
(xxxii) Clen. ..	—	+	—	—	—	+++	+++	++	+	—	—	—	—
(xxxiii) Tay. ..	—	+++	+	—	—	++	+	—	—	—	—	—	—
Control Type I ..	—	—	—	—	—	+++	+++	++	++	—	—	—	—
Control Type II (homologous)	+++	+++	+++	+++	++	—	—	—	—	—	—	—	—
Control Type II (heterologous)	++	+++	+++	+++	(+)	+++	+++	+++	++	—	—	—	—
Control Type III ..	—	—	—	—	—	+++	+++	++	++	—	—	—	—
" " IV ..	—	—	—	—	—	+++	+++	++	++	—	—	—	—

In the above results attention is called to the following cocci:—(iv) Ja., (v) D., (viii) Hug., (xii) Gr., (xvii) Br., (xviii) Eng., (xxi) Win., (xxii) McP., (xxiii) C., (xxvi) Ou., (xxxi) Wy., and (xxxii) Clen. These cocci, it is to be noted, failed to absorb the specific agglutinin from this serum, and number eleven out of thirty-three. The results obtained, therefore, are not so clear cut as are those obtained in the case of Types I, III and IV.

The following table illustrates the saturation of serum prepared from another Type II coccus of spinal origin—coccus Mi.:—

TABLE VIII.

TYPE II. SERUM MI.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated				Saturated				Saturated			
		Test coccus added				Homologous coccus added				Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
A′ A.	++	+++	+++	+	−	−	−	−	−	−	−	−	−
B′ Ja.	+	+++	++	+	−	++	−	−	−	−	−	−	−
C′ D.	+	++	−	−	−	+++	++	(+)	−	−	−	−	−
D′ St. (N.P.) ..	++	+++	+++	++	−	−	−	−	−	+	−	−	−
E′ Mi.	++	+++	++	+	−	−	−	−	−	−	−	−	−
F′ Har.	++	+++	+++	++	+	−	−	−	−	−	−	−	−
G′ F.	+	++	−	−	−	++	++	−	−	−	−	−	−
H′ Br.	+	+++	−	−	−	++	++	−	−	−	−	−	−
I′ Eng.	+	++	+	−	−	++	−	−	−	−	−	−	−
J′ Ou.	+++	++	+	+	−	−	−	−	−	−	−	−	−
K′ St. (C.S.F.) ..	++	+++	++	++	−	−	−	−	−	++	−	−	−
L′ Clen.	−	−	−	−	−	++	+	(+)	−	−	−	−	−
M′ Tay.	+++	+++	+++	++	+	−	−	−	−	−	−	−	−
N′ Eo.	+	+++	++	+	+	+	−	−	−	−	−	−	−
O′ Bas.	++	+++	+++	+++	++	−	−	−	−	−	−	−	−
P′ Bur.	+	+++	+++	++	−	−	−	−	−	−	−	−	−
Q′ To.	++	+++	+++	++	++	−	−	−	−	−	−	−	−
R′ Brook... ..	−	−	−	−	−	+++	++	++	−	−	−	−	−
S′ New.	(+)	+	(+)	−	−	−	−	−	−	(+)	−	−	−
T′ Wy.	+	++	++	+	−	(+)	−	−	−	−	−	−	−
Control Type I ..	−	−	−	−	−	+++	+++	+++	++	−	−	−	−
,, ,, II (homologous)	++	+++	+++	+++	++	−	−	−	−	−	−	−	−
Control Type II (heterologous)	++	+++	+++	++	+	−	−	−	−	−	−	−	−
Control Type III ..	−	−	−	−	−	+++	+++	+++	++	−	−	−	−
,, ,, IV ..	−	−	−	−	−	+++	+++	+++	++	−	−	−	−

It will be seen from these results that this serum is more specific in respect of saturation than is serum "H." Of twenty cocci examined with "Mi." serum only three failed to qualify as Type II meningococci, viz., C′ D., L′ Cl., and R′ Brook, which do not

TABLE IX.

Type II. Serum H.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated: Test coccus added				Saturated: Homologous coccus added				Saturated: Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
(i) A. ..	−	++	+	−	−	−	−	−	−	−	−	−	−
(iv) Ja. ..	++	+++	+++	+++	(+)	+++	+++	+++	++	−	−	−	−
(v) D. ..	−	+++	(+)	−	−	+++	+++	+++	++	−	−	−	−
(x) St. (N.P.) ..	++	+++	+++	++	+	+++	++	−	−	−	−	−	−
(xiv) Mi. ..	−	++	(+)	−	+	++	++	−	−	−	−	−	−
F' Har.	+++	+++	+++	+++	++	−	−	−	−	−	−	−	−
(xvi) F. ..	+	+	−	−	−	+	−	−	−	−	−	−	−
(xvii) Br. ..	−	++	+	−	−	++	+	(+)	−	−	−	−	−
(xviii) Eng. ..	+	−	−	−	−	+++	+++	+	(+)	−	−	−	−
(xxvi) Ou. ..	+	+++	++	+	−	+++	+++	++	+	−	−	−	−
(xxviii) St. (C.S.F.)	++	+++	+++	++	+	++	++	−	−	−	−	−	−
(xxix) New. ..	++	+++	+++	++	+	−	−	−	−	−	−	−	−
(xxxi) Wy. ..	(+)	++	++	−	−	+++	+++	++	+	−	−	−	−
Control, Type I ..	−	−	−	−	−	+++	+++	++	++	−	−	−	−
,, ,, II (H. coccus)	+++	+++	+++	+++	++	−	−	−	−	−	−	−	−
Control, Type II (M. coccus)	++	+++	+++	+++	(+)	+++	+++	+++	++	−	−	−	−
Control, Type III ..	−	−	−	−	−	+++	+++	++	++	−	−	−	−
,, ,, IV ..	−	−	−	−	−	+++	+++	++	++	−	−	−	−

Type II. Serum M.

	Agglut. 1/50 for 24 hours at 37° C.	Unsaturated: Test coccus added				Saturated: Homologous coccus added				Saturated: Test coccus added			
		1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
(i) A. ..	++	+++	+++	+	−	−	−	−	−	−	−	−	−
(iv) Ja. ..	+	+++	++	+	−	++	−	−	−	−	−	−	−
(v) D. ..	+	++	−	−	−	+++	++	(+)	−	−	−	−	−
(x) St. (N.P.) ..	++	+++	+++	++	−	−	−	−	−	+	−	−	−
(xiv) Mi. ..	++	+++	++	+	−	−	−	−	−	−	−	−	−
F' Har.	++	+++	+++	++	+	−	−	−	−	−	−	−	−
(xvi) F. ..	+	++	−	−	−	++	−	−	−	−	−	−	−
(xvii) Br. ..	+	+++	−	−	−	++	++	−	−	−	−	−	−
(xviii) Eng. ..	+	++	+	−	−	++	−	−	−	−	−	−	−
(xxvi) Ou. ..	+++	++	+	−	−	−	−	−	−	−	−	−	−
(xxviii) St. (C.S.F.)	++	+++	++	++	−	−	−	−	−	++	−	−	−
(xxix) New. ..	(+)	+	(+)	−	−	−	−	−	−	(+)	−	−	−
(xxxi) Wy. ..	+	++	++	+	−	(+)	−	−	−	+	−	−	−
Control, Type I ..	−	−	−	−	−	+++	+++	++	++	−	−	−	−
,, ,, II (H. coccus)	++	+++	+++	++	+	−	−	−	−	−	−	−	−
Control, Type II (M. coccus)	++	+++	+++	+++	(+)	−	−	−	−	−	−	−	−
Control, Type III ..	−	−	−	−	−	+++	+++	++	++	−	−	−	−
,, ,, IV ..	−	−	−	−	−	+++	+++	++	++	−	−	−	−

reduce the titre of this serum sufficiently to permit of their being regarded as unequivocal Type II cocci. Attention is called to the fact that while "Mi." coccus fails to remove the agglutinins from "H." serum, "H." coccus, on the contrary, removes the agglutinins from "Mi." serum. This suggests that those cocci which are provisionally classed as Type II really represent a complex group which is divisible into different varieties, some of which react like coccus "Mi.," others like coccus "H." The former is apparently more specific than the latter, and is included in the latter.

With a view to testing the validity of this suggestion those cocci (provisional Type II) which were alive on a given date—thirteen in number—were tested in duplicate with "Mi." serum and "H." serum. Table IX gives the results obtained on carrying out this experiment.

It will be seen that all thirteen organisms completely saturate or markedly reduce the titre of serum "Mi.," but only eight of these reacted similarly to "H." serum. Again, the controls show that the power of "Mi." coccus for saturating "H." agglutinins is poor, while the "H." coccus completely saturates "Mi." serum and the results obtained with other cocci are comparable with those indicated in Tables VII and VIII.

Attention is called to the discrepancy between the result obtained when using a fresh emulsion of coccus "Mi." with that obtained when a stock emulsion of the same coccus was employed. The former agglutinates poorly in presence of H. serum, but saturates that serum fairly well; while the latter agglutinates well but saturates not at all.

It is such discrepancies between cocci recently isolated and those maintained in culture over long periods that make the saturation test when applied to Type II peculiarly difficult from a technical standpoint.

The results tabulated in Table IX tend to confirm our thesis that the cocci, which can be provisionally classed as Type II, really comprise a complex group.

So far all the cocci provisionally classed as Type II qualify as members of that group on saturation of one or other serum, so far employed, with the exception of (v) D., (C′ D.), (xxxii) Clen., (L′ Clen.), and R′ Brook. which qualify on investigation with neither serum; while (viii) Hug., (xii) Gr., (xxi) Win., and (xxiii) C., fail to qualify on investigation with one serum—"H."

Table X is a synopsis of these results.

In order further to investigate this question of the complex

nature of the Type II sub-group a serum was prepared by inoculating an animal with coccus (v) D., one of those cocci which had so far failed to qualify as a Type II organism on application of the saturation test.

TABLE X.

Coccus	H. serum	Mi. serum
(i) A.	+	+
(ii) M.	+	
(iii) Cl.	+	
(iv) Ja.	—	+
(v) D.	—	—
(vi) No.	+	
(vii) H.	+	+
(viii) Hug.	—	
(ix) W.	+	
(x) St. N.P.	+	+
(xi) Sh.	+	
(xii) Gr.	—	
(xiii) Gl.	+	
(xiv) Mi.	+	+
(xv) Gi.	+	
(xvi) F.	+	+
(xvii) Br.	—	+
(xviii) Eng.	—	+
(xix) Co.	+	
(xx) Pal.	+	
(xxi) Win.	—	
(xxii) McP.	Auto	
(xxiii) C.	—	
(xxiv) Bar.	+	
(xxv) Ba.	+	
(xxvi) Ou.	—	+
(xxvii) Pla.	+	
(xxviii) St. C.S.F.	+	+
(xxix) New.	+	+
(xxx) Fis.	+	
(xxxi) Wy.	—	+
(xxxii) Clen.	—	—
(xxxiii) Tay.	+	+

+ = Saturation complete or marked.
— = No saturation.
Blank = Experiment could not be done.
Auto = Experiment unsatisfactory owing to coccus becoming auto-agglutinable.
Note.—Number (xiv) Mi. is the result obtained with a fresh emulsion of the coccus, not with a "stock" emulsion.

Table XI illustrates the results obtained when this serum was employed.

Twenty-two of these cocci therefore show complete saturation of this serum and, of these twenty-two, eleven also completely saturated H. serum, indicating that there is a distinct relationship between the two organisms H. and D.; and showing that (v) D.,

(xxxii) Clen., (xxi) Win., (viii) Hug., and (xii) Gr., all qualify as Type II cocci on investigation with the serum prepared from organism D. (v).

TABLE XI.

SERUM D.

	Unsaturated				Saturated				Saturated			
	Test coccus added				Homologous coccus added				Test coccus added			
	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400	1/100	1/200	1/300	1/400
(xxvi) Ou. ..	++	++	++	++	–	–	–	–	–	–	–	–
(ii) M... ..	–	–	–	–	++	++	+	+	–	–	–	–
(xxxi) Wy. ..	++	++	+	–	+	+	–	–	–	–	–	–
(xxvii) Pla. ..	–	–	–	–	–	–	–	–	–	–	–	–
(vii) Hu. ..	++	–	–	–	++	++	++	+	–	–	–	–
(vi) Mo. ..	++	+	–	–	++	++	++	+	–	–	–	–
(v) D.	++	++	++	+	–	–	–	–	–	–	–	–
(iii) Cl.	–	–	–	–	++	++	++	(+)	–	–	–	–
(xiv) Mi. ..	++	++	–	–	–	–	–	–	–	–	–	–
(xvi) F.	++	+	–	–	+	–	–	–	–	–	–	–
(xvii) Br... ..	++	++	++	+	–	–	–	–	–	–	–	–
Ev. ..	++	–	–	–	++	–	–	–	–	–	–	–
(iv) Ja	++	++	++	+	–	–	–	–	–	–	–	–
(xxi) Win. ..	++	+	–	–	++	+	–	–	–	–	–	–
(xxx) Fis. ..	++	+	(+)	–	–	–	–	–	–	–	–	–
(xii) Gr. ..	+	+	–	–	–	–	–	–	–	–	–	–
(xxiii) C.	–	–	–	–	+	+	–	–	–	–	–	–
(x) St. (N.P.)..	++	++	+	+	++	+	+	+	++	++	+	+
(xxviii) St. (C.S.F.)	++	++	+	+	++	+	+	–	++	+	–	–
(xxix) New. ..	++	++	+	+	(+)	–	–	–	–	–	–	–
(i) A.	++	++	+	–	+	+	–	–	–	–	–	–
(xxv) B. D. ..	++	+	–	–	+	–	–	–	–	–	–	–
(viii) Hug. ..	++	++	+	+	–	–	–	–	–	–	–	–
(xi) Sh. ..	++	++	+	–	–	–	–	–	–	–	–	–
(xiii) Gl	++	++	++	+	–	–	–	–	–	–	–	–
(xxxiii) Tay. ..	++	+	(+)	–	–	–	–	–	–	–	–	–
(ix) W... ..	++	+	–	–	+	–	–	–	–	–	–	–
(xxxii) Clen. ..	++	+	–	–	–	–	–	–	–	–	–	–
(xxiv) Bar. ..	–	–	–	–	++	+	+	–	–	–	–	–
(xix) Co. ..	++	+	–	–	–	–	–	–	–	–	–	–
(xxii) McP. ..	++	++	+	+	++	+	+	–	++	++	+	+
F Har. ..	+	–	–	–	++	+	–	–	–	–	–	–
(xviii) Eng. ..	+	+	–	–	+	–	–	–	–	–	–	–
(xx) Pal. ..	++	+	–	–	–	–	–	–	–	–	–	–
Control Type I ..	–	–	–	–	++	++	++	+	–	–	–	–
,, ,, II, D.	++	++	++	++	–	–	–	–	–	–	–	–
,, ,, III ..	–	–	–	–	++	++	++	+	–	–	–	–
,, ,, IV ..	–	–	–	–	++	++	++	+	–	–	–	–

Finally, the relation between the three organisms which have been used as examples of the different varieties of Type II is shown in the following table, which is a synopsis of the results obtained

with those provisional Type II cocci which I was able to test with all three sera, "H.," "Mi.," and "D."

Coccus	H. serum	Mi. serum	D. serum
(xxvi) Ou.	−	+	+
(xxxi) Wy.	−	+	+
(v) D.	−	−	+
(xvi) F.	+	−	−
(iv) Ja.	−	+	+
(xxix) New.	+	+	+
(i) A.	+	+	P.
F Har.	+	+	P.
(xxviii) Eng.	−	+	+
(xxxii) Clen.	−	−	+

+ = Complete or marked saturation.
− = No saturation.
P. = Result equivocal.

Considering the above results one notes that four of the ten cocci saturate "H." serum, seven "Mi." serum, and eight "D." serum; one coccus saturates all three sera; seven saturate two; and only two saturate one. We are justified, therefore, in considering the cocci provisionally classed as Type II as belonging to a single group, complex in character, although marked individual variations occur among the cocci; some being markedly specific in their serological reactions, for example (v) D. and (xxxii) Clen. Others, for example (xxix) New., are non-specific, while the majority are relatively specific in that they saturate two out of three of the sera.

Considering all the cocci provisionally classed as Type II only three remain which could not definitely be placed in the sub-group. Owing to these cocci having died I was unable completely to investigate them and place them in one or the other of the Types I, III, or IV.

Conclusions.

(1) The relative numbers of the various types of cocci investigated over a given period are as follows:—

Total	=	107	
Type I	=	30	
,, II	=	41	
,, III	=	13	
,, IV		17	
Could not be placed		6	3 of which died before investigation was completed, while 1 was obtained from a case of posterior basic meningitis.
		107	

It is therefore suggested that polyvalent therapeutic sera should be rich in Type I and Type II antibodies.

(2) The differentiation of types is perfectly clear in the case of sub-groups I, III, and IV.

(3) Sub-group Type II appears to be complex; there are marked individual variations in the cocci of this group. Its members are easily differentiated from the other types of meningococci and from the meningococcus-like organisms frequently found in the naso-pharynx, but the differentiation of the varieties of Type II cocci *inter se* is not easy.

Note.—The agglutination reactions of Type II cocci are more definite when the organism is tested soon after isolation than when examined after prolonged culture.

(4) The saturation test shows group relationship between Types I and III, and to a less extent between Types I and IV; while other relationships, notably that between II and IV exist, they are not so striking in degree, nor of such frequent occurrence.

(5) The investigation shows that agglutination of meningococci with 1/50 dilution of specific sera having a titre equal to 1/400 to 1/600 is non-specific. It is therefore advised that investigation of the meningococcus by serological methods be conducted using only a standard technique.

Note.—I understand that the authorities at the Pasteur Institute, who have received cultures of the four types of meningococcus, regard Types I and III as being varieties of the meningococcus, and Types II and IV. as belonging to the para-meningococcus group of Dopter.

The Amara Clinical Society.

THIS Society was started by Officers of the Mesopotamia Expeditionary Force stationed at Amara at the end of September. The A.D.M.S. Amara (Lieutenant-Colonel C. A. Stone, R.A.M.C.) was elected *ex officio* President, and a small Executive Committee was formed as follows: Lieutenant-Colonel E. W. W. Cochrane, R.A.M.C. (Chairman); Lieutenant-Colonel S. Anderson, I.M.S.; Major Grey Turner, R.A.M.C. (T.); Major F. P. Connor, I.M.S; Lieutenant F. R. Barwell, R.A.M.C.; Major F. P. Mackie, I.M.S. (Honorary Secretary). The first meeting of the Society took place on Friday, October 6, 1916, and about eighty-nine officers were present.

The subject of Scurvy was introduced by Major F. P. CONNOR, I.M.S., who pointed out the principal characters of the disease at present met with in Amara, and laid particular stress on the influence of the environment in the causation of the disease. Captain KAMAT, I.M.S., then showed a series of five cases in various stages of the disease, and pointed out the signs and symptoms which had been referred to by the introducer. He said that the chief symptoms complained of are: (1) pain and bleeding from the gums; (2) general debility and lassitude; (3) pain in the back and joints; and the signs present are: (1) some degree of anæmia; (2) inflammatory condition of gums; (3) hæmorrhages in various localities; (4) general debility.

As regards the involvement of the gums there is much variation, but generally these signs are severe and are exaggerated by a previous septic or pyorrhœic condition of the gums and teeth. Hæmorrhages are very common and are generally situated in the popliteal space, the calf, the ankle or the flexor surface of the forearm. These hæmorrhages are generally very hard, and there is generally some discoloration of the overlying skin.

The question of caste, race, dietary, have been carefully inquired into in a series of 130 cases, but no definite conclusion could be arrived at. Other debilitating influences such as malaria, hook-worm disease, etc., were not proved to influence the incidence of scurvy.

Local treatment should be directed to the teeth, which should be scraped, and if pockets are present these should be swabbed out with hydrogen peroxide and quinine powder dusted along the margin of the gums.

General anti-scorbutic treatment was carried out on the usual lines, and a medicinal mixture of limejuice, rum and tr. nucis vom. given thrice a day. A discussion then followed in which Lieutenant-Colonel

PALMER, R.A.M.C., laid stress on certain early symptoms to be looked for in the diagnosis of scurvy.

Major HEATHCOTE ROBERTS, I.M.S., referred to the more serious complications of scurvy, such as amblyopia, cerebral and meningeal hæmorrhage, infective pneumonia, gangrene and hæmothorax, all of which he had met with from time to time.

Major REYNOLDS, I.M.S., pointed out that scurvy often appeared under conditions where it would be least expected, and referred to some cases which he saw in an otherwise healthy regiment in a place where fresh vegetables were abundant and freely partaken of. He also said that, though the condition of the gums was a valuable indication of the severity of the disease, it was apt to be misleading, in that markedly scorbutic persons may show perfectly healthy gums and teeth.

Major GREY TURNER, R.A.M.C.(T.), speaking from surgical experience amongst British troops, referred to three groups of cases which he had observed :—

(1) Where the presence of scurvy explained the occurrence of otherwise obscure cases of hæmatoma and other hæmorrhages.

(2) Where wounds or ulcers took on a sluggish and unhealthy character owing to the presence of scorbutic changes, and

(3) Where patients under treatment for enteric group diseases or dysentery developed spontaneous hæmorrhages. These he considered were probably due to a diet of preserved milk and were probably comparable to scurvy rickets (Barlow's disease).

The first group he exemplified by a British soldier who developed a large hæmorrhage in the popliteal space supposed to be due to marching, but in reality to scurvy, as the subsequent course of the disease proved. In another case a large hæmorrhage around the femur was so hard and defined as to simulate new growth. This was disproved by X-ray examination and the result of treatment. He remarked that sometimes the only confirmatory signs were a thin red line on the gums and small subcutaneous hæmorrhages or petechiæ on the lower limbs. In the third group secondary infection of the extravasated blood and suppuration not infrequently occurred. The first and second groups responded readily to treatment, but in the last group the prognosis was bad as it indicated profound nutritional disturbance.

Major CONNOR replied.

An interesting specimen was shown by Captain McCALLAN, R.A.M.C. (S.R.). It showed perforation of the heart and the overlaying border of the lung caused by a stab from an Arab dagger.

Captain CHAPMAN, R.A.M.C., then gave a demonstration of the use of the new Roger's cholera outfit which had just been issued to hospitals. He described fully the indication for and method of its use and emphasized the following points :—

Normal blood-pressure in British	115–120
,, ,, ,, ,, Indians	100—110
Normal specific gravity	1,054—1,056
Critical blood-pressure	70
Specific gravity	1,063
Specific gravity below which blood should not be diluted	1,050
Rate of flow	4 oz. per minute for the first 4 or 5 pints, then 1 oz. per minute

The second meeting took place on October 20. The President being in the chair, the subject of paratyphoid fever was introduced by Lieutenants Feiling and Batt, R.A.M.C., and continued on the bacteriological side by Captain Stevenson, I.M.S. An interesting discussion followed. The number of officers present was eighty-one.

Lieutenant B. E. A. Batt, R.A.M.C., and Lieutenant A. Feiling, R.A.M.C. read a paper on the "Clinical Aspect of Paratyphoid Fever." Their remarks were confined to the disease as they had found it in Mesopotamia, and that was nearly always paratyphoid A. Their experience was founded on over 300 cases treated at No. 2 British General Hospital. The onset might be sudden or insidious, more commonly the latter. Headache, abdominal pain, and general weakness were the most prominent early symptoms. The cases with sudden onset were chiefly characterized by rigors, intense headache, with high fever, and had not infrequently been mistaken for heatstroke. The average duration of the disease had been found to vary from nineteen to thirty-five days or more, exceptionally over forty days. The cardinal features in the symptomatology were discussed in detail, and briefly were found to be: (1) the type of the fever, emphasis being laid on the spiky character and tendency to undulations exhibited by the temperature charts; (2) the pulse, slow rate, soft and frequently dicrotic character, had proved a point of considerable diagnostic value; (3) the appearance of the tongue, which was found with a relatively clean tip and edges; (4) the enlargement of the spleen, a nearly constant feature: when palpable, it felt harder and firmer than the average typhoid spleen, when not palpable an enlarged area of splenic dullness could generally be demonstrated by percussion. In their experience the rash had not proved a constant and reliable sign. Complications had on the whole been uncommon and unimportant, with the exception of hyperpyrexia, which had proved disastrous during the hot season, but with the advent of cooler weather had been rarely seen. Bronchitis, broncho-pneumonia and myocarditis had been found in all the fatal cases. Phlebitis, parotitis, with and without suppuration, and periostitis had occurred. Hæmorrhage and perforation had luckily been uncommon. Of three cases of perforation in their series one had survived. Diarrhœa had been decidedly uncommon, and constipation the rule. The co-existence of other diseases, notably malaria, sandfly fever and dysentery, produced a puzzling symptom complex. Their mortality had reached the high figure of 10·4 per cent, but

it was significant to note that out of thirty-nine deaths thirty had occurred in the month of July, i.e., in the hottest part of the summer. Actually the most common of deaths had been cardiac failure from a profound toxic myocarditis. In one case hæmorrhage and in two cases perforation had been responsible for the fatal issue. They had found the ulceration to be generally less extensive than in typhoid, with a greater tendency to involvement of the large bowel. To establish a diagnosis, two questions had to be answered.

First, Was the case one of enteric group infection? and secondly, What member of the enteric group of the organisms was responsible? The first question was answered by the detailed description of the symptoms. The second had to be answered by the pathologist, and was left to another speaker to discuss. Numerous charts were exhibited illustrating the more common types of fever, and many of the complications described, such as relapses, hyperpyrexia, sandfly fever, malaria and dysentery. Special stress was laid on the close similarity between certain charts of cases of paratyphoid fever and of cases of malaria, especially the malignant tertian variety.

Captain STEVENSON, I.M.S., then spoke on agglutinins.

After a very brief description of the close relationship between the members of the enteric group, the speaker addressed himself chiefly to the interpretation of results derived from agglutination tests carried out by the Staff of the Central Laboratory, Amara.

The diagnosis of typhoid fever from agglutination results is full of fallacies. The factor of previous inoculation has to be considered. A high reaction to the typhoid bacillus in such a case is of little significance unless it can be shown in subsequent examinations that the agglutination titre is an ascending one. Again, in infection by the paratyphoid A bacillus the group agglutinin for the *Bacillus typhosus* often is the earliest to appear.

As a rule, the true specific agglutinin for *B. typhosus*, developed in the course of typhoid fever, appears early—from the seventh day of disease—may rise rapidly but will remain high, in the great majority of cases, for weeks or months.

During infection by paratyphosus A not only may the specific A agglutinin be developed but the group agglutinin for typhoid and paratyphoid B are usually thrown up—the latter more rarely, and these group agglutinins may develop earlier than the true specific agglutinin, causing great difficulty in the true interpretation of results.

This specific agglutinin for paratyphosus A is often very transient, as was pointed out long ago in India by Colonel Firth and Captains Gratton and Wood of the Royal Army Medical Corps. Again, it may never rise very high, and a reading of full agglutination in 1 in 20 dilution in a person not previously inoculated with the triple or "T.A.B." vaccine is very suggestive, and in 1 in 30 dilution almost conclusive of paratyphoid A fever.

Owing to the fact that this paratyphoid A agglutinin is so often transient, it follows that even in repeated tests it may be missed altogether. A guide to this would appear to be the behaviour of the group typhoid agglutinin. As stated, this may appear early and may rise very high. But, unlike the typhoid specific agglutinin developed in typhoid fever, it exhibits a great tendency to fall quickly—not invariably, however.

Taking one actual instance—a patient of Captain Hendry, R.A.M.C. On September 10 the readings were typhoid positive in 1 in 360 dilution. On September 14 typhoid positive 1 in 20 dilution. Paratyphoid A and B were negative on both occasions. Both readings were taken towards the end of his fever—the exact day of disease cannot be given. The rapid drop in the typhoid agglutinin led him to suspect that it really was a case of paratyphoid fever. On September 17 the patient had a relapse and on the 24th his serum gave the following agglutination results: Typhoid positive in 1 in 360 dilution. Paratyphoid A positive in 1 in 20 (complete) and partial in 1 in 60 dilution. Paratyphoid B negative in 1 in 20 dilution. (Some charts were passed round showing the behaviour of the specific paratyphoid A agglutinin.)

Of the paratyphoid B bacillus we have had little experience. Its incidence has diminished gradually among British troops, and we have not during the last three months found any case amongst Indians. So far as the diagnosis of paratyphoid B from serum reactions is concerned, the only guide would appear to be a higher titre of reading for paratyphoid B than for paratyphoid A and an increasing one: a diagnosis on a single reading would be unjustifiable.

Some cases were quoted when positive results from both cultural and agglutination tests had been obtained.

The difficulty of interpretation of agglutination results will be heightened by the increasing use of "T.A.B." vaccine. The only way will be to arrive at some idea of the normal reaction of the individual.

Several tests will be necessary, and according as the specific agglutinin remains steady, rises, or in view of the behaviour of specific and group agglutinins in paratyphoid A fever, falls, will diagnosis be possible.

Some of the results obtained during the last six months, with those of Major F. P. Mackie, I.M.S., and Captain Jones, R.A.M.C. (T.C.), of the Central Laboratory, which owing to their kindness he was able to include, lead to the following percentage results.

The actual figures were:—

From April to September inclusive, agglutination tests done .. 1,379

of which

Paratyphoid A was diagnosed in 196	.. ..	14·2 per cent
Paratyphoid B ,, ,, ,, 26	.. ..	2 ,,

It is not possible to be certain of the typhoid figures, but they were low.

Blood cultures. Total 393

B. typhosus recovered ..	15 =	3·8 per cent
B. paratyphosus A recovered	33 =	13·5 ,,
,, ,, B ,,	3 =	under 1 per cent

These figures are inclusive of Indians. Among Indians there were no cases of paratyphoid B and the proportion of *B. typhosus* infections to *B. paratyphosus* A infection was as one to five.

Captain Chapman, R.A.M.C., gave the following summary of the cases admitted under his care at "D" 2, British General Hospital.

Abstract of Cases of Enteric Group
(Including Transfers from other Hospitals).
Admitted between March 1 and May 11, 1916.

Total number of cases admitted		134		
Total number of cases inoculated against enteric ..		127 (94 per cent)		
"Enteric Group"	= 35	Percentage	=	26·11
Typhoid ..	= 18	,,	=	13·43
Paratyphoid A ..	= 59	,,	=	44·02
Paratyphoid B ..	= 22	,,	=	16·41

Deaths.

Total number of deaths	= 7	Percentage	=	5·22
"Enteric Group"	= 2	Percentage	=	1·49
Typhoid ..	= 1	,,	=	0·74
Paratyphoid A ..	= 4	,,	=	2·98
Paratyphoid B ..	= *nil*	,,	=	*nil*

Abstract of Cases
Diagnosed by Blood Examination (Agglutination Curve),
by Professor Dreyer's Method.
Number of cases .. 106

"Enteric Group"	= 7*	Percentage	=	6·60
Typhoid ..	= 18	,,	=	16·98
Paratyphoid A ..	= 59†	,,	=	55·66
Paratyphoid B ..	= 22	,,	=	20·75

* = Reaction indeterminate.
† = Includes 12 cases of mixed infection A and B.

Lieutenant-Colonel Palmer, R.A.M.C., stated that the most characteristic features of the disease in his experience were: (1) fever often of an undulatory character, and sometimes accompanied by singularly few symptoms, the tongue in many cases remaining surprisingly clean; (2) marked tendency to relapse; (3) absence of complications as a rule. (4) To this however there was one striking exception: gall-bladder involvement was exceedingly common in paratyphoid A infection and pain over that organ a frequent symptom. In a series of cases he had seen in this country a slight tint of jaundice or icterus was visible in nearly half the cases, but how much of this was due to the hot weather was difficult to determine. He also remarked on the sandfly fever type of temperature, where after an initial pyrexial curve resembling sandfly fever the temperature fell, but not quite to normal, remaining about 99° or a little over for perhaps as long as a week, eventually developing a char-

acteristic cure. He also suggested that there might be some connexion between the lack of agglutinins as determined in the laboratory and the well-known tendency to relapse so characteristic of this infection.

Major L. REYNOLDS, I.M.S., remarked: Cases he had known in India in which paratyphoid fever was of a very mild nature might readily have been overlooked unless a blood culture had been made. He related one case in particular where had it not been for a positive blood culture it would have been hard to believe the patient had had paratyphoid fever. He remarked on having seen cases of fever in India due to *B. paratyphosus* B which had been isolated in the Brigade Laboratory and confirmed by the Enteric Laboratory at Naini Tal.

Lieutenant G. W. SPENCER, R.A.M.C. pointed out the importance of a schedule of systematized diets, dealing with large numbers of patients, untrained orderlies made this very desirable. By its means the work of making up the diet summaries was considerably lessened, and the danger of patients getting food which had not been ordered for them was reduced. He passed round a schedule of diets which had been in use for some months in the paratyphoid wards at the 32nd British General Hospital, and which had been found to work smoothly and efficiently. It was his practice to give light food to patients if there was no distension of the abdomen, a normal stool, a clean tongue and the patient had an appetite.

Major G. GREY TURNER, R.A.M.C. (T.), drew attention to cholecystitis as a complication of the typhoid group. There were some few cases in which the clinical evidence of infection of the gall-bladder was sufficient to justify a diagnosis of cholecystitis almost certainly post enteric in origin, but they cleared up under medical treatment, and he wished more especially to refer to some cases in which he had found it necessary to operate. One man had an acute inflammation with patches of gangrene of the fundus of the bladder; there were no calculi and he made good recovery after drainage. Unfortunately it was not possible to get a bacteriological report in that case, but the history strongly supported its enteric group origin. In a second case, a youth of 21, there were numerous gall-stones and a paratyphoid A bacillus was grown from the bile. In a third case the man had an old history of gall-stones and suddenly developed an acute cholecystitis without any antecedent illness which might be interpreted as of the enteric group. A culture of *B. typhosus* was obtained from the bile. Subsequently an enormous calculus was removed from the common duct. In the fourth and fifth cases the patients were diagnosed as suffering from enteric infections when the complicating cholecystitis developed and in both an enteric group organism was recovered. In a sixth case of the same type the clinical history was that of an enteric infection, but the bacteriological examination of the bile was not yet complete.

Lieutenant FRANCIS JONES, R.A.M.C., and Lieutenant F. G. THOMPSON, R.A.M.C., also spoke and the meeting then terminated.

Clinical and other Notes.

A NOTE ON THE MODE OF EXISTENCE OF FLIES DURING WINTER.

By Captain R. P. McDONNELL.
Royal Army Medical Corps.

AND

Staff-Serjeant T. EASTWOOD.
Royal Army Medical Corps.

At the present time, but little is known as to the way in which flies pass the winter under natural conditions. It has generally been accepted that flies in the adult state hibernate in concealed positions, either outside in hay stacks and under thatches, or within dwellings, but it would appear much more natural for the winter to be passed in the pupal stage. During the last winter, in spite of the extreme cold experienced in the latter part of February and the earlier part of March, adult flies have continued to appear in houses, hutments and elsewhere in France, their appearance generally following a spell of a few days sunny weather.

Most investigators maintain that flies in their fully developed form are hibernating insects. We have hitherto been led to believe that about the month of October in each year, the fly betakes itself to some suitable retreat—which has yet to be discovered—and lying dormant throughout the winter, emerges in the late spring or early summer to begin again the propagation of its species, and become progenitor of the earliest broods of the approaching fly season. On the other hand, it has been held by a few, that all flies die off about October or November, and that the persistence of the species is secured by the careful selection on the part of the female fly of a suitable hatching ground for her eggs, where they can be undisturbed throughout the wiuter, and on the advent of the warm weather hatch out the larvæ.

Accordingly investigations were undertaken with a view to throwing some light if possible on the question as to how the generation of flies is linked up from season to season.

One of us (Staff-Serjt. Eastwood) has made many searches for hibernating flies, but so far has never been able to discover flies in that condition.

We are inclined to believe that eggs which are deposited in the manure and refuse dumps in late autumn are the sources from which the yearly "plague of flies" originates, and that the hatched-out larvæ in a dormant state persist throughout the winter and come to the surface in the spring or early summer.

With a view to testing this hypothesis careful and systematic examination of numerous manure dumps and disused trench latrines was undertaken.

Investigations were pursued and on March 3, 1917, living larvæ were found in a heap of old manure at a depth of three feet. This manure heap had been lying untouched since October, 1916, and at the time of our investigation was covered with grass and weeds. Larvæ were also discovered on March 20 at a depth of two feet in a mixture of dry earth and human excreta, which had been made in September, 1916. This collection had a covering of six inches of earth. Pupæ which in the larval state had evidently migrated from the manure and excreta heaps were found about two feet from the respective dumps lying at a depth of about one inch below the ground surface. The larvæ were placed in a wide-necked bottle containing manure, and covered with wire gauze and placed in a warm room. Within twenty-four hours of removal from the manure heap almost all had assumed the pupal stage; one or two still remain in the larval stage (April 14). During the first week of April these pupæ developed into flies, some of which proved to be *Fannia canicularis* and others *Musca domestica*. Larvæ found at a depth of two feet in a manure heap were apparently dead, but revived when exposed to heat; evidently they were hibernating.

These preliminary observations open up a new field of investigation and indicate the inadequacy of the present hypothesis that the summer "plague of flies" is mainly dependent upon the survival throughout the winter of the adult fly in some suitable nook or cranny.

It would not be justifiable to draw definite conclusions from the few isolated observations here recorded, which are preliminary only. Further experiments and observations on a much more extended scale are necessary. Assuming, however, the correctness of our observations it would appear that the fly either passes the winter in the pupal stage as do many insects, or that fly larvæ may even have the power of undergoing hibernation with intervals for feeding during the spells of warmer weather. This would mean that the period of their life-history was considerably lengthened; it is known that fly larvæ do not mature for probably several weeks when fermentation of their food supply does not take place.

In the case of manure heaps, the most fruitful source of fly life, it would seem that ova deposited in the late autumn and covered over, or otherwise buried in the heap, may in consequence of the warmth in the depths of the manure, hatch out into larvæ, continue to feed and eventually pupate. In this stage they may remain dormant until the spring, or may develop into adult flies, hatched out by a few warm days, the heat of which is able to penetrate the superimposed layers of manure; this may account for the fact that adult flies are frequently encountered in the winter time.

The finding of living fly larvæ and pupæ in such numbers in manure heaps is especially remarkable on account of the extreme cold during the late winter when from 18 to 20 degrees of frost were experienced for many days.

If these assumptions are correct it would appear that manure heaps may be a source of danger at any time of the year, and if the spread of flies is to be prevented, manure should either be burnt, or spread out in thin layers; dumping in the immediate vicinity of camps and buildings should be avoided. Covering over the heaps with earth, or sowing the surface with grass or other seeds, would appear to be of doubtful value once eggs are deposited in the manure.

In the month of March, the presence of living fly larvæ was demonstrated in a mixture of earth and human excreta made six months previously; it would seem therefore that reliance cannot always be placed on the method of disposal in shallow trench latrines as a preventive of fly breeding; in some soils the disappearance of excreta is slow.

Further investigations on this subject are proceeding.

A FEW NOTES ON THE VENEREAL DIVISION OF GENERAL HOSPITAL, ALEXANDRIA.

By Captain W. C. JARDINE.
Royal Army Medical Corps.
Officer in Charge.

Owing to the large number of troops in Egypt the question of dealing with admissions from venereal disease became an important one, and it was considered advisable by the D.M.S., the Force in Egypt (Surgeon-General Sir R. W. Ford, K.C.M.G., C.B., D.S.O., A.M.S.), to open a central venereal hospital in Alexandria, for the treatment of all cases of venereal disease occurring amongst British troops in Cairo, Alexandria and surrounding camps. It was considered that the treatment of these cases in one central hospital would be more successful and uniform than if all hospitals treated their own admissions for venereal disease, and this has undoubtedly proved to be the case. To open this hospital as quickly as possible and at the same time to utilize the medical personnel and equipment at present existing, it was decided to make the venereal hospital a division of a General Hospital under the command of Colonel C. W. R. Healey, A.M.S.

This division opened in January, 1916, with accommodation for patients in E.P.I.P. tents and in huts.

Staff.

When the hospital is full one medical officer is detailed to every 100 venereal patients, but this percentage is reduced as the number of patients

in hospital decreases, the medical officers not required being returned for temporary duty to the General Hospital. The number of orderlies required to carry on the work efficiently is five to six per cent of the patients; this of course includes clerks, cooks, pack store, linen store and sanitary men.

Six Arabs are employed for doing the rough and very dirty work; such as cleaning the latrines, picking up paper, carrying dirty dressings to the incinerator and emptying night urine buckets.

Patients.

The patients are not asked to do regular hard work, but they are held responsible for the tidiness and cleanliness of their tents or huts and the ground surrounding them. They also carry on stretchers any patients who are not able to walk up to the dressing rooms; they also help in the dining hall and kitchens.

Duties and Discipline.

The N.C.O. patients wear their chevrons, and on them falls to a certain extent the responsibility of good order being maintained in the compound. A patient N.C.O. is put in charge of the patients in each tent or hut and is held responsible for their good conduct. He has orders to detail one or more men daily to act as hut or tent orderlies, whose duties consist in sweeping or scrubbing out the tent or hut, drawing bed patients' meals and returning all bed patients' dirty dishes to the dining-hall scullery.

The senior N.C.O. patient is put in charge of the outside of the tents and huts and the surrounding grounds. He has power to fall in a fatigue party of patients to do any *pioneer* work, such as generally cleaning up, adjusting guy ropes, etc.

There is a detention compound into which patients who commit serious breaches of discipline are put, the charges being forwarded to the Officer Commanding of the man's unit on discharge.

Patients undergoing sentences are kept also in this compound.

Feeding Arrangements.

With an occasional exception, the patients are fed on one of the following diets: (1) Ordinary; (2) milk.

Ordinary.—This diet is given to all patients who are up and going about. These patients eat all their meals in the dining hall, to which they are called at meal times by a bugle. The only extra allowed to this diet at first was cocoa, but, as some of the patients put in a strong complaint that the food was not sufficient, a further ¼ pound of bread, ½ ounce of butter and 2 ounces of jam were allowed.

Milk.—This is given to all patients who are in bed. They eat this in their tents or huts, the food being carried to them by the hut or tent orderlies for the day.

N.B.—The Government issue of tobacco and matches is issued to all patients who wish it.

The Dining Hall.

A Royal Army Medical Corps non-commissioned officer is put in charge of this and is responsible for the issuing of all food. He is assisted in this work by a voluntary fatigue party of patients, to join which there seems to be considerable competition. Each table seats eighteen persons, i.e., the occupants of two E.P.I.P. tents, and has stencilled on the wall above it the numbers of the two tents whose occupants sit there.

By making the patients sit at the tables by tents we found that the food was more evenly served, there was not any rush for seats, and that the N.C.O. patient in charge of the tent could, by being with his own men, keep better order.

The food is served in the kitchen in large hot-water diet tins, one for each table, the N.C.O. in charge of the dining hall having previously notified the sergeant cook how many diets are required for each.

The senior N.C.O. at the table then issues the food to the patients.

Attached to the dining hall is a large scullery, in which all the washing up is done. The patients are not allowed to take their plates out of the dining hall, nor are they allowed to wash them themselves, on account of a certain type of patient neglecting to wash his plate thoroughly or not at all, and thereby decoying a number of flies, which at certain seasons are very plentiful in this district, into his tent.

Latrines, Ablution Benches and Baths.

The block of buildings containing these conveniences is divided into two parts, each of which contains eighteen w.c.'s, six shower baths, one plunge bath, a three-stall urinal, and a long ablution bench.

The gonorrhœal patients use one part, the syphilis, venereal sore and soft chancre the other. When the hospital first opened the w.c.'s were provided with the usual tip-up wooden seats over the porcelain pans, but these had to be removed as some of the patient's, fearing infection from their friends, kept soiling them by adopting Nature's posture on the top of the w.c.'s. The inmates now fearlessly sit on the rim of the porcelain pan knowing that it is frequently washed with cresol.

Laundry.

The linen is now washed at the laundry of the General Hospital. All clothing from the venereal compound is stamped with a "V" so that it can easily be distinguished from the rest of the hospital things. Patients get a clean change of linen, etc., once a week or oftener if necessary, and all articles are disinfected by being put through a steam disinfector before being sent to the laundry, and articles badly soiled by blood or pus being soaked in cold water before steaming to avoid fixing of the stains.

Recreations.

The men are provided with a recreation hut, which has been furnished with all kinds of games, literature and stationery by the Red Cross Association. The recent addition of a piano has been a great boon. A Circulating Library is run from the Recreation Hut, thus enabling men to take books to quiet spots and read if so inclined.

Medical Treatment.

Dressings.—All dressings, local applications, etc., are done in the dressing-rooms, of which we have four under the supervision of the medical officers. Arrangements are made by which each medical officer has the use of a room for a certain period each day, and during that period his orderly marches up all patients who require dressings, those who are unable to walk being carried on stretchers.

Diagnosis of Venereal Diseases.

Venereal sores { Syphilis.
Soft chancre.

Possibly as a result of the lectures on venereal disease which have been given to troops in Egypt, and of the stories told by the venereal patients on discharge from hospital, we find that the soldiers report sick very early, in fact usually as soon as the sore appears. On this account we rely a great deal on our bacteriologist for an early diagnosis of syphilis. Cases with well-marked secondaries are diagnosed clinically and put under treatment at once. Cases on admission who are suffering from a sore or sores only are divided into two classes:—

(1) Those who have had no treatment at all, local or general.

(2) Those who have had treatment, local or general.

(1) Those of this class are dressed with saline solution on the night of admission and are sent to the bacteriologist next morning for an examination of the exudate.

(*a*) If the spirochæte is found the patient is put under anti-syphilitic treatment.

(*b*) If no spirochætes are discovered, the person, *pro tem.*, is diagnosed soft chancre, but if before the sore heals and the man is fit for discharge, any suspicious syphilis symptoms appear a Wassermann is done, and the diagnosis confirmed or corrected according to the result.

(2) (*a*) Those of this class who have had simple antiseptic dressings are dressed in salines for a week and then are treated as Class 1.

(*b*) Those whose local application has taken the form of cauterizing, or have had a long course of local treatment, have a Wassermann done.

(*c*) Any man who has a sore and has had any general treatment (mercurial) is diagnosed as syphilis and continues with the treatment.

N.B.—The examination of the exudate is done by dark-ground illumination.

GONORRHŒA.

Acute.—This as a rule presents little difficulty, the man usually admitting exposure and giving a typical history. A few men with profuse urethral yellow discharge denied exposure and gave various curious explanations for its presence. Gonococci were found in all these cases except in one—a very young Colonial—who absolutely denied having ever exposed himself. As his condition cleared up in a few days with simple irrigation, he was discharged as non-venereal.

Chronic and Recurrent.—The majority of this class of case admit a previous attack, and the few who do not, as a rule, admit it when as a result of vigorous prostatic massage they see the discharge appearing.

A microscopic examination of the secretion of the prostate of all men with "gleet" who deny venereal disease is made, and the diagnosis made on the result (vide below).

Careful digital examination of the prostate and bacteriological examination of the secretion after massage usually clear up any difficulty in diagnosis. The urethroscope sometimes gives very valuable information which explains the persistence of the discharge.

TREATMENT OF VENEREAL DISEASE.

(1) *Syphilis. The Sore.*—This is always dressed by, or under the supervision of the medical officer in the dressing-room in which aseptic or antiseptic precautions can be observed. In most cases the sores are treated early and heal up under general anti-syphilitic treatment, plus a simple mercurial local dressing, in two or three weeks. Some sores have presented considerable resistance to treatment, our experience of these cases being that if the sore is not in an excisable position the best treatment is to ionize with 1-1,000 lotio hydrarg., and later to paint with zinc. sulph., gr. x ad ℥i.

The Mouth.—All syphilitic patients are warned that neglect of the mouth may lead to loss of health in addition to interfering with their treatment and prolonging their stay in hospital. A simple antiseptic tooth powder is prescribed for patients who require it, and we issue brushes to those who have none and replace defective ones.

General: Salvarsan, mercury.

Salvarsan.—The usual course given, when the case is got early, is two injections (each 0·6 gramme), with an interval of at least fourteen days between them, but men who report sick in the secondary stage get three injections each 0·6 gramme. A certain number of patients—considered unfit for a full dose—are given several small doses of 0·3 gramme until the requisite amount considered necessary for the case has been administered.

Preparation of Patient.—All patients are carefully examined for nephritis, phthisis, arteriosclerosis and cardiac affections and the dose the

patient will tolerate determined by the result. The patient is given a sharp purge the night before and put on milk diet for twelve hours before and twenty-four hours after the injection.

The Solution.—The solution is prepared by dissolving 0·6 gramme in 100 cubic centimetres sterile distilled water, neutralizing with a four per cent solution sod. hydrate, and then adding 0·8 per cent warm saline solution till the total equals 250 cubic centimetres.

The Injection.—This is given in the salvarsan room. This room is fitted up with four complete salvarsan outfits and each medical officer is allotted certain days and hours during which he may use one. The injection is given intravenously in the usual way—a preliminary injection of saline being given through the needle to ensure that the salvarsan will go into the vein.

After-Treatment.—The patient is put to bed and ordered to remain there till next morning.

Results of Injections.—In the majority of cases the patient makes no complaint after his injection, in fact he, as a rule, grumbles at having to stay in bed. Some develop temperatures with vomiting and diarrhœa (this was specially noticeable after the use of one lot of kharsavan) and a few develop erythematous or urticarial rashes.

Mercury.—In addition to the course of salvarsan each patient is given 9 grains of mercury intramuscularly, either as six weekly injections of 1½ grains or nine weekly injections of 1 grain, or a mixture of these doses according to the weight of the patient and the tolerance he shows for the drug.

The preparation of mercury used is the ordinary grey oil (one grain hydrarg. in ten minims).

The injection is made deep into the upper part of the gluteal muscles.

Results of Injections.—The majority of patients suffer little inconvenience from their mercury beyond a little stiffness and tenderness. A certain percentage develop gingivitis—especially men with septic mouths, and a few develop nephritis (slight), which soon clears up under general treatment and stoppage of the mercury for a week or two. The most alarming symptoms after injection of the drug which has been observed in this hospital is cardiac dilatation with marked tachycardia. Two patients exhibited this phenomenon to such an extent that for a few days fears as to their recovery were entertained. The condition in both cases came on suddenly and in neither case could other signs of mercurialism be detected. Both patients were transferred from the V. Compound to a cool ward in the General Hospital and under general medical treatment happily made a speedy recovery. Two or three men have developed temperatures and headaches after each injection of one grain. They tolerated the drug so badly that they were given an extra salvarsan injection and received the rest of the mercury due by inunction.

Syphilis Out-patients.

As soon as a man has had his two salvarsan injections and three injections of mercury he is discharged from hospital for duty temporary class "B." provided that he is free from infection. These men are attached to one of the detail camps where they do light duty, e.g., guards and pickets, and they attend each Friday morning for further treatment until completion of their course of mercury. One medical officer or more if necessary is detailed each week to attend to these out-patients. He first examines them for mouth trouble and excuses any whom he does not consider fit to have an injection, marking mercurialism on the man's A.F.I. 1238. He then examines all their urines—admitting any who have albumin—and administers the necessary dose to those who are fit. The men then return to their camp for further duty. To ensure that Officers Commanding detail camps allow the men to attend hospital each man is given a chit (specimen below) requesting that the man may attend.

[*Specimen of* "*Chit.*"]

The Officer Commanding Base Details,

....

No....... Rank............ Name................ Unit..............

The above-mentioned man has had *part* of his anti-syphilitic treatment. He is free from infection and fit for temporary Class "B" duty. He should report to me every Friday morning at 9 a.m. for further treatment until completion of course, please.

Venereal Division,	Capt. R.A.M.C.,
General Hospital,	Officer in Charge,
Victoria College,	Venereal Division,
Alexandria.	
................1916.	....

This system of running an out-patients' department has worked very well, the men reporting regularly for treatment. Early in the year, when troops were being moved about, we lost a *few men* who had not completed their full course of mercury, but as all these men have their A.F.I. 1238 with them or with their regimental medical officers they probably would get the remaining doses on arrival overseas. The advantages gained by getting the convalescent syphilis cases out of hospital early is obvious.

Record of Syphilitic Cases.

An improvised syphilis register is kept, in which is noted the dose and date of each injection of salvarsan and the amount of mercury given to each patient. An A.F.I. 1238 is made out for each man in the usual way. These A.F.'s I. 1238 in the case of the British troops are sent to the D.D.M.S. lines of communication, Cairo, monthly when the treatment is complete. In the case of Australian and New Zealand troops they are sent to the medical officer in charge or their base training depot at Tel-el-Kebir, as all Australian and New Zealand patients discharged from hospital are sent to those depots.

Gonorrhœa.

In the acute stages the men are kept in bed on a milk diet for a *few days* and then let up on ordinary, so generally speaking our gonorrhœa patients get cured on a diet which contains meat.

Drugs.—The use of drugs per orem, such as ol. santale and copaiba, is rarely resorted to. New medical officers sometimes will prescribe them for a period, but they very soon recognize that man's stomach is easily enough upset in this climate without throwing on it the extra strain of negotiating these medicines. Mist. hexamethylenetetramine is used a lot and does not appear to cause gastric disturbances.

Irrigations.—All gonorrhœa patients irrigate, from the day of admission, one, two or three times daily according to necessity, the medical officer being the judge. The irrigation fluid is warm 1 in 10,000 lot. pot. permang., the hot water being obtained from Soyers' stoves. Each patient is taught the art of irrigation by the medical officer or by the trained Royal Army Medical Corps orderlies in charge of the irrigation room.

The Irrigation Room.—This contains eighteen stalls, each of which is fitted up with an ordinary douche can (which hangs six feet six inches from the ground) rubber tubing with stop cock, a waterproof apron, and a small wooden stool. A part of this room is set apart as a sterilizing and injection room. The nozzles used are Maiocchis metal double channel, and for aseptic reasons we have in use twice as many nozzles as douche cans. The Royal Army Medical Corps orderly has a nominal roll of all patients on irrigation. On this roll are stated the following particulars: No, Name, Tent, Number of irrigations daily, Irrigation fluid, Injection fluid. The irrigation room is opened three times daily at the following hours: 9.15 to 11.30 a.m., 2.30 to 3.45 p.m., 6 to 7.30 p.m. Patients for irrigation are paraded outside the room. Eighteen men go in and each takes a douche can from a stall. Each fills this with warm water from a Soyers' stove, and then goes to the orderly, who puts in the requisite amount of lot. pot. permang., and hands to the patient a sterilized Maiocchis nozzle. The patient then takes his outfit to his stall, hangs up the douche can and irrigates. When finished he detaches the nozzle from the rubber tubing and hands it to the orderly for sterilization. He then gets a urethral injection of:—

Lot. zinc. sulph., gr. j ad ℥ j,
or Lot. ac. picric, 1 per cent solution,
or Protargol, ½ per cent to 1 per cent solution,
or Eusol, 0·25 per cent,

according to the state of his disease and the fancy of his medical officer. The second batch go through the same procedure, only that they use the other set of nozzles; those used for the first batch being boiled in the meantime for the third and so on. Men who fail to attend for irrigation are punished.

Prostatic Massage.—This is carried out in cases suffering from subacute and chronic posterior urethritis by either the medical officers or nursing orderlies and the results certainly justify the time and labour expended.

Ionization.—Ionization of the posterior urethra with zinc. sulph. ¼ per cent solution *is* used but not generally in chronic post-urethritis. Amongst other methods used in chronic cases are dilatation with large bougies and the use of the water-heated bougie.

Vaccines.—Obstinate sub-acute and chronic cases are treated with vaccines, which are made in our own laboratories.

Test of Cure.—As soon as a gonorrhœa case reports that he has been free from discharge for two days his treatment is stopped, and he is ordered to hold his morning urine till the medical officer or the assistant wardmaster sends for him to pass it in the urine testing-room (this is very easily done in this climate). If the specimen is free from threads or "floaters" he is ordered to repeat this in two days. If this second specimen is satisfactory he is discharged. If the first specimen is not free from threads he is put back on treatment for a few days and if still free from discharge has another attempt to pass what he calls a "water test." Cases of "gleet" who suffer from an early morning bead are treated with irrigations, massage, vaccines, etc., but if the case is one of long standing we do not insist on a cessation of the discharge as a cure. These patients have their prostates vigorously massaged and a smear is made of the resulting secretions. If, on examination of this slide, the bacteriologist finds no gonococci, the patient is sent out to duty.

Soft Chancres.—These are treated on general surgical lines—the antiseptic used being mercurial. The best results here are obtained by ionizing the sore with 1-1,000 lot. hydrarg. perch. and if it is indolent, stimulating it with lot. zinc. sulph. gr. x ad ℥j.

Duration in Hospital.

The average period in hospital for patients has been: Syphilis, thirty-nine days; gonorrhœa, thirty-four days; soft chancre, thirty days.

AN OUTBREAK OF INFECTIOUS JAUNDICE OCCURRING AMONG THE SOLDIERS OF THE BRITISH FORCES.

By Lieutenant-Colonel GRAHAM CHAMBERS.
Canadian General Hospital.

During the months of November and December, 1915, 201 cases of "jaundice" were admitted to a Canadian General Hospital. This afforded us an excellent opportunity for the study of the disease. Unfortunately at the time we were not in a position to carry on a very careful study owing partly to the great number of patients who were being admitted every day, and partly to our hospital not having had sufficient time for full establishment. We did, however, make a few observations which we think worthy of mention.

The clinical picture of the affection is somewhat similar to that of the so-called catarrhal jaundice. As in the latter disease there is a pre-icteric stage during which subjective symptoms of disease, especially of the gasto-intestinal tract, are present In our cases the common inaugural symptoms were a sensation of fullness and pressure in the region of the stomach, loss of appetite, nausea, vomiting, abdominal pain, headache, pain in the limbs and weakness. Chilliness was present in probably about fifteen per cent of the cases. The characteristics of the abdominal pain were fairly constant. In the great majority of cases it was located in the epigastrium and was of a dull nature. In a considerable number the pain was of a colicky nature and located in the region of the umbilicus. The latter variety of pain was not infrequently associated with diarrhœa. It was sometimes excited by the ingestion of food. Several patients who had suffered from diarrhœa stated the stools were of a greenish colour during the first few days of their illness.

The subjective symptoms of gastric disturbance were variable, but suggest the presence of acute gastritis. Nausea and vomiting were common prodromal symptoms, the former occurring in about ninety per cent and the latter in about fifty per cent of the cases. In a few there was neither nausea nor vomiting. In interpreting the clinical significance of these symptoms we should, however, keep in mind the fact that a mild degree of acute gastritis may exist without nausea and vomiting, or indeed without any subjective symptom. This was first recognized, I think, by Dr. Beaumont in his memorable observation on the Canadian, Alexis St. Martin. As evidence in favour of the same view, we may mention that chronic gastritis frequently exists without causing any subjective symptom.

In order to definitely diagnosticate an affection as acute gastritis, one has frequently to examine the gastric contents after a test meal. In our study of the cases we examined the gastric contents of five patients with the following results:—

Case 1.—Examination on the fourth day of disease and the second of the icterus. Subjective symptoms of acute gastritis at the commencement. Gastric analysis: Total acidity, 25; free HCl, absent; excess of mucus.

Case 2.—Examination on the fifth day of disease and the second of the icterus. Subjective symptoms of acute gastritis at the commencement. Gastric analysis: Total acidity, 15; free HCl, absent; excess of mucus.

Case 3.—Examination on fifth day of icterus and probably the eighth of the disease. Inaugural symptoms: Loss of appetite, sensation of fullness, nausea, vomiting and diarrhœa. Gastric analysis: Total acidity, 50; free HCl, 25; mucus possibly in excess.

Case 4.—Examination on the fifth day of the disease and the second of the icterus. Subjective symptoms of acute gastritis at the com-

mencement. Examination of gastric contents showed absence of free hydrochloric acid and excess of mucus.

Case 5.—Examination on eighth day of icterus and the twelfth day of disease. Subjective symptoms of acute gastritis before the incidence of the icterus. Gastric analysis normal.

It will be observed that in the cases in which the gastric contents were examined before the sixth day of the disease there were chemical signs of gastritis. This evidence, considered along with the fact that the subjective symptoms of acute gastritis are common prodromal symptoms, indicates that acute gastritis is at least frequently present in the early stage of the disease.

The motility of the bowels in pre-icteric stage was variable. Constipation was a very common symptom, but in a number, probably 15 per cent, diarrhœa was an inaugural symptom. I may state, however, that a large proportion of the patients gave a history of having suffered from one or more attacks of diarrhœa during last summer. For this reason it was difficult to interpret the clinical significance of the symptom. We think, however, that it forms an important part of the symptom complex for the following reasons: (1) Patients who suffered from diarrhœa at the commencement of the disease frequently exhibited a tendency to the same disturbance during the later stages; (2) in a considerable proportion of the cases diarrhœa developed during the second or third week of the affection; (3) in many patients suffering from diarrhœa during the attack there was no previous history of intestinal disturbance since enlistment.

The icteric stage of the disease usually began on the second to the fifth day of the disease; in a few cases the discoloration of the conjunctiva was not detected until the sixth or seventh day.

Icterus was present in all the cases on admission to the hospital. There was nothing unusual about the icterus in itself. The degree of discoloration of the tissues and urine was very variable. Pruritus was present in only a few cases. Slowness of the pulse was common; in one case the frequency was reduced to 47 per minute. The urine contained bile pigment and bile salts and not infrequently a trace of albumin and hyaline and granular casts.

During the icteric stage subjective symptoms were, as a rule, less marked than at the commencement of the disease. Indeed many patients had little or no complaint and did not exhibit any abnormal temperature. The majority did, however, suffer from a variety of symptoms, of which headache, pain in the back and limbs, abdominal pain and diarrhœa were the most important.

Diarrhœa or a tendency to this disturbance was present in about 25 per cent. of the cases. Diarrhœa was observed not only in some of the cases in which it was a prodromal symptom but also in others in which constipation or normal movements of the bowels were present at the commencement of the disease. The diarrhœa was frequently

associated with a good deal of pain. In some patients who had normal movements of the bowels on a liquid diet the ingestion of solid food would excite both abdominal pain and diarrhœa. The stools in these cases frequently contained little, if any, mucus. All these characteristic suggest that the small intestine was involved.

The diagnosis of an enteritis limited to the small intestine is not an easy matter, for it is possible for it to exist without producing a diarrhœa. The motility of the small gut, relative to that of the large intestine, is so active that one can conceive of a considerable degree of inflammation of the former, at least of its upper part, without giving rise to diarrhœa; but abdominal pain in such a condition is likely to be present. Again in an inflammation of the small gut one should expect to find loss of weight among the manifestations, on account of the disturbance of both digestion and absorption of food. I may state that loss of weight was an outstanding symptom in some of our cases, notwithstanding the fact that they were taking sufficient food to maintain nutrition. Pain in the region of the umbilicus after eating is a symptom of an inflammation of the small intestine. This was also a common symptom in many of the cases treated in the hospital. We think, therefore, that the view that there is an inflammation of the small intestine in all the cases of infectious jaundices is in keeping with the clinical facts.

The objective symptoms during the icteric stage were more marked and included enlargement of the spleen and liver, distension of the gall bladder, loss of weight, slight leucocytosis in addition to the manifestation caused by the retention of bile.

The condition of the spleen is a point of first-rate importance. In about 15 to 30 per cent of the cases it was palpable and hard, resembling in these characteristics the enlargement of the spleen one frequently observes in paratyphoid fever. I may mention in this connexion that the marked enlargement of the spleen in these cases suggests the presence of a general infection.

In the case of the patients who remained in the hospital until cured the enlargement eventually disappeared.

Enlargement of the liver was very common. In not a few cases it extended two inches below the right costal border. Along with the enlargement of the liver one could make out by percussion signs of distension of the gall-bladder, but we were only able to definitely palpate in one case. We ascribed our failure to palpate the gall-bladder partly to tenderness and rigidity in the region and partly to the marked development of the recti in soldiers.

The condition of the blood in the icteric stage is worthy of mention as it has a bearing on the pathogenesis of the disease. In fifteen cases characterized by fever, in which blood counts were made, the number of white blood corpuscles varied from 9,000 to 19,000 per cubic millimetre. It is interesting to note that a blood count of 9,000 to 13,000

was observed in some cases in which temperature was within the normal limits. In four cases characterized by a good deal of fever and severe pain and tenderness in the region of the gall bladder, which we ascribe to cholecystitis, the blood counts were between 15,000 and 19,000.

A feature about this type of infectious jaundice which has been called attention to by some physicians is enlargement of the right heart. This was not an outstanding manifestation in our cases. We did, however, find it present in a few cases. The sign is of special interest because it is difficult to explain its origin. In one case in which the sign was present the rate of the pulse was slow, which may be a factor in the causation of the phenomenon.

Conclusions.

(1) The icterus in this form of infectious jaundice is caused by a cholangeitis which usually develops secondarily to a gastro-enteritis.

(2) The enteritis is mild and limited to the small intestine in the majority of cases.

(3) The disease is caused by a bacterial infection which is general, at least in the cases characterized by marked enlargement of the spleen.

A METHOD OF TREATMENT FOR CONJUNCTIVITIS.

By Captain FREDERICK JEFFERSON.
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AND
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The treatment of conjunctivitis is an important problem for doctors in the region of the firing line. The ordinary treatment is sometimes ineffective, and often slow, with the result that many valuable men in excellent general health are rendered incapable of service for considerable periods, owing to the state of their eyes. What is wanted is a treatment which will be at once more effective and more rapid; and it is also necessary that it should be capable of ready application to large numbers of men, and under circumstances in which the facilities for applying even the most simple remedies may, perhaps, not be very great.

Some of the cases of conjunctivitis are traumatic in origin, others are dependent upon and secondary to some other diseased condition, but most of the cases appear to be simple bacterial infections of the conjunctiva, and so should be susceptible to treatment by ordinary recognized anti-bacterial methods.

Experience has shown that immunization procedures are peculiarly

applicable to many eye inflammations. Gonococcal, tubercular, and sometimes streptococcal, infections of the organ often give most excellent results when treated with the corresponding vaccine. But simple uncomplicated conjunctivitis is apparently seldom due to any of these organisms, and its bacteriology is so inconstant that to apply vaccine therapy would hardly be practicable under war conditions. It is, however, safe to say that any conjunctivitis cases in which styes are present as a complication should certainly be treated with staphylococcus vaccine.

The value of an antiseptic would appear to depend largely, if not altogether, upon the histological position of the invading bacterial Army. When the bacteria are superficially disposed, an antiseptic is the most obvious agent by which they may be destroyed. In this process the tissues themselves will suffer injury and death, but such cellular losses will be replaced from the practically illimitable resources of the body, while the superficially-placed bacteria have no such reserves to draw upon. When, however, bacteria have penetrated more deeply, and have established for themselves in the tissue labyrinth bases where no antiseptic can reach, they can keep up a continuous stream of recruits, which, in a war of antiseptic attrition, will be as proof against extermination as the cells of the organ they have invaded. In such a case antiseptics are not only useless, but probably harmful, for, by devitalizing the tissues, they hinder the physiological forces from trying to accomplish the bactericidal effect which the antiseptic itself has no hope of accomplishing.

In conjunctivitis the inflammation is placed about as superficially as it is possible for any inflammation to be. It is the condition above all others in which we might expect an efficient antiseptic to produce good results. Now, the substances used for the treatment of conjunctivitis are as a rule more distinguished for their astringent than for their antiseptic properties. We thought it would be interesting, and probably profitable to try the effect of a remedy in which the antiseptic prevailed over any other action, and after some deliberation we chose eusol solution as the reagent best suited to carry out the idea.

We selected eusol for the following reasons:—

(1) It is the most powerful antiseptic known.

(2) It seems strangely non-irritating to the tissues, almost as though it might imitate faintly with regard to bacteria the action of 606 with regard to a more developed form of microbe life.

(3) It has apparently already given good results in the hands of some reliable workers in the field of general surgery, though, so far as we know, it has not yet been used in infections of the eye.

The investigation was carried out in the following manner. Acting on advice kindly furnished by Professor Lorrain Smith, we commenced with a solution of eusol ten times more dilute than that used in the treatment of wounds. It speedily appeared, however, that this was too weak, and that a solution about five times more dilute than the normal strength

used for wounds gave the optimum effect in the treatment of conjunctivitis. Every second case of conjunctivitis was treated by irrigating the conjunctival sac freely three times a day with eusol; the other cases were treated with boric acid and zinc sulphate solution as being probably the commonest of routine methods.

We took the cases absolutely in the order that they happened to arrive from field ambulances. The only thing that was done in the way of selection was to exclude from the experimental group those cases in which any complications co-existed with the inflammation of the conjunctiva. Cases of blepharitis, corneal ulceration, trichiasis, entropion, and ectropion seemed to us to present incalculable elements, the inclusion of which would be likely to lead to ambiguous and uncertain conclusions.

One hundred cases were treated in this comparative manner. Of these hundred cases the fifty treated by eusol took an aggregate time of 303 days to cure. The cases treated by boric and zinc took 448 days before they were fit for duty.

The employment of eusol therefore resulted in the saving of many days in the treatment, the average time required for a cure with eusol being 6·06 days, as against the average time of 8·96 days required to get the same result with boric and zinc treatment.

It was further apparent as the result of our work that apart from any gain in time, eusol might yet be a very useful alternative measure for the treatment of conjunctivitis, for in six cases it succeeded in effecting a rapid cure of the disease where boric and zinc had proved unsatisfactory.

TWO CASES OF REMOVAL OF A BULLET FROM THE UPPER SURFACE OF THE DIAPHRAGM.

By Captain E. D. TELFORD, F.R.C.S.
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Whilst the lessons of war surgery have thrown much light on the immediate treatment of penetrating wounds of the chest and have prompted some most valuable additions to surgical literature, the later consequences of these injuries have received but little notice.

It is a fortunate fact that not a few of these seriously wounded men recover; but, of these, some still carry in their chests the agent, whether shell or bullet, which caused the injury. These foreign bodies show a tendency to fall to the bottom of the thorax, coming to rest there on the upper surface of the diaphragm. In this position they may give rise to no trouble and no surgeon would suggest their removal. There are found, however, from time to time, cases in which the foreign body is a cause of persistent and distressing symptoms.

In the first case which I report the man's life was made miserable by a constant "pricking" pain and, in the second case, the soldier was quite incapable of any exertion owing to the fact that an increase of respiratory movement beyond the normal produced at once a crippling amount of pain. The two cases are reported, not merely as examples of removal of foreign bodies from an unusual situation, but rather as instances of the help afforded to the surgeon by a simple method of "positive pressure anæsthesia." Thanks to this method, most ably handled by Major A. Wilson, the recovery of a bullet from the pleural cavity was carried out with perfect safety to the patient and was rendered, from the operator's point of view, little more than a minor surgical procedure. The details of the cases are as follows:—

(1) G. W. C., aged 24, was wounded in the right side of the chest by a rifle bullet fired at long range. The bullet entered through the right costal interspace, 3½ inches from the middle line. Free hæmoptysis occurred at once and continued in considerable quantity for twenty-four hours. He reached England at the end of five weeks and during this time he had much pain in the lower part of the right chest with frequent cough and daily hæmoptysis.

Although he stated on admission to the 2nd Western General Hospital that he had lost two stones in weight since his injury his general condition was excellent. The chest expanded well and beyond a few moist sounds there was no physical sign of disease or injury. Cough was frequent and the sputum always contained a little dark blood. The patient, although apparently well and comfortable in a sitting posture, was not able to lie down with ease and was rendered very breathless by slight exertion. He complained constantly of a "pricking" pain which he located deep to the sixth right costal cartilage.

Radiographic examination by Captain Bythell disclosed an intact rifle bullet lying on the upper surface of the diaphragm. The bullet was localized at a depth of two inches beneath a point marked over the sixth right costal cartilage and distant ½ inch from the line of the right border of the sternum. As the pain continued after a month in hospital and the patient's condition remained without change, save that the hæmoptysis had ceased, it was decided to attempt the removal of the bullet.

Anæsthesia was induced by chloroform and the tracheal catheter of the Ehrenfried's positive pressure apparatus having been introduced, the operation was carried out under ether vapour introduced under pressure by bellows. Through a curved skin incision the sixth and seventh right costal cartilages were exposed and denuded of their muscular and tendinous coverings, which were reflected downwards in one piece. A portion, 1½ inches in length, of each costal cartilage was then excised. The opening thus made gave abundant access and through it the parietal pleura was incised in a horizontal direction. A healthy, well-inflated

lung presented itself on opening the pleura. The lung appeared and felt absolutely normal, showing no trace of adhesions.

On packing off the lung with a strip of gauze there was disclosed at once on the upper surface of the diaphragm a rounded eminence, in shape and size like the half of a small walnut shell. An incision into this yielded a few drops of turbid fluid and the bright unbroken nose of the bullet at once presented. This was seized and extracted without difficulty; it was lying on the upper surface of the diaphragm and had become covered and encysted by a pale friable fibrous tissue. The gauze was removed and the parietal pleura closed tightly by a continuous stitch of fine chromic gut. The tendino-muscular flap was replaced by chromic gut sutures and the wound closed without drain. The colour and general condition of the patient were perfectly satisfactory throughout the operation. Beyond a slight tracheitis, probably traumatic, which cleared up completely in three days, the convalescence was uninterrupted. The patient was discharged from hospital in four weeks. The "pricking" pain disappeared from the first and the man was able to move freely without breathlessness.

(2) T. J. E., aged 21, was hit by a shrapnel ball at Suvla Bay. He stated that very free bleeding followed the injury—"blood running out of his mouth without cough." He gradually recovered and does not appear to have suffered from any complications of the injury beyond occasional slight hæmoptysis which continued up to the time of his admission to the Royal Infirmary, six months after the injury. At this time the chest showed no abnormal physical signs and his general condition was excellent. The scar of the wound of entry lay over the inferior angle of the left scapula.

The patient complained of much pain on exertion and located the pain at a point on the tenth left rib a little in front of the mid-axillary line; he stated that the pain was very severe on deep breathing.

A radiogram by Captain Barclay showed an intact shrapnel bullet lying deep to the rib and fixed in the angle between the diaphragm and chest wall. Anæsthesia was carried out, as in Case 1, by Major A. Wilson with the help of Ehrenfried's apparatus. The operation was of the simplest nature. A portion of the tenth rib about 1½ inches long was resected and the pleura opened by a horizontal incision. The bullet was at once evident and was picked without effort off the upper surface of the diaphragm. The edge of the well-inflated lung was well seen and as far as it could be inspected through the limited opening the lung appeared to be quite healthy and free. The pleura was closed with fine chromic gut.

The after-history was quite without incident; the patient was discharged in a fortnight in excellent condition, having had neither hæmoptysis nor his former pain since the operation.

A SANITARY BOX LATRINE.

By Lieutenant-Colonel E. J. WILLIAMS.
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During the first week of the month of August, 1915, the Australian and British Forces made an advance on the Turkish position at Gallipoli capturing several trenches and killing large numbers of Turks. On account of the incessant gun fire it was impossible to remove or bury the dead, with the consequence that when the advance trenches were gained they were found to be filled with decomposing dead bodies, besides being in a most unsanitary condition in other particulars. This also applied to the areas around the trenches.

The temperature at this time was ranging between 80° F. and 90° F. and the flies very abundant. The difference in the prevalence of flies in the British and Turkish positions was remarked upon by many of the men who were in action and who were admitted to hospital at Mudros a short time later.

About the middle of the month an epidemic of dysentery broke out on the Peninsula. These cases were transferred in large numbers to hospitals on Lemnos Island which were soon filled to overflowing. The situation here was most trying during the months of August and September, due, first to the large number and the nature of the cases treated, and second to the fact that fully thirty per cent of the hospital personnel were off duty through the same malady.

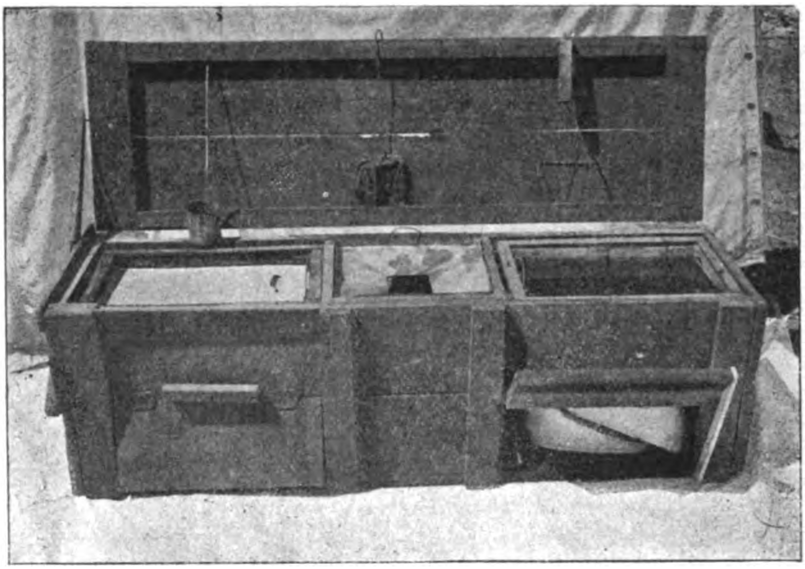
In order to prevent the spread of the infection it was found necessary to devise some scheme by which the excreta of dysentery and typhoid patients could be disposed of quickly and safely. The sanitary box was constructed and one placed at the end of each hut which accommodated forty-five patients. In this way it was necessary for the ward orderly to walk only a few yards to empty, cleanse, and sterilize the bedpan, and at the same time obtain a fresh bedpan which had already been sterilized.

For a time, the average number of dysentery patients in hospital was 400. Allowing a very low average of five stools in twenty-four hours for each patient, this means that the bedpans must be emptied 2,000 times during this period. Under ordinary conditions this cannot be carried out efficiently, but with a special receptacle placed a short distance from each hospital ward, such a number can be handled quickly and safely, with very much less effort on the part of the orderlies and with a greater degree of efficiency in the matter of sterilization of the bedpan.

The proof of the efficiency of this service lies in the fact that the number of patients in hospital for conditions other than dysentery and who contracted this malady while in hospital, markedly diminished in the month following the introduction of this system.

The sanitary box is practical in the extreme, being composed of boxes and tins which have served as containers for supplies from Ordnance and are available in all camps. The structure is quite simple and can be made by anyone who has the elementary knowledge of carpentry. The following extract explains the system.

The sanitary box (latrine) has been devised primarily with the object of disposing of the excreta of patients suffering from infectious enteric diseases, quickly and safely.



With a large percentage of all patients in hospital suffering from simple diarrhœa, or dysentery, it is impossible for the regular staff of orderlies to deal thoroughly and quickly with stools unless some provision be made for the disposal of the same at a place not far removed from the hospital lines.

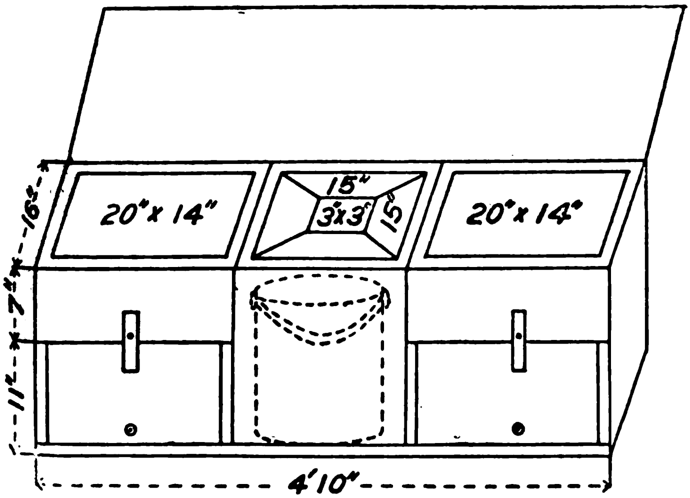
Each box latrine will serve for seventy-five to 100 patients, the excreta pail being emptied as often as required. The frame of the box is made of lumber planed on the inside so that the surface can be scrubbed clean. The ordinary oil drum serves for the excreta pail, a wire having been added for a handle. This section is covered with a tin protecting top sloping on four sides towards the centre, which is provided with a three-inch square opening in the centre. This allows of the excreta being poured into the centre of the pail without any possibility of any being spilled about the box. On each side of the pail is placed a tin-

lined box, one containing water for the rinsing and the other cresol solution 2½ per cent for the sterilizing of the bedpans. The ordinary canned goods boxes are used for this purpose and can always be had in abundance in camps, while the tin lining is made from discarded biscuit tins. The space beneath these boxes is used for bedpan cupboards. The box should be kept clean at all times and thoroughly scrubbed with cresol solution each day. A bedpan mop with handle, also a small dipper, is provided, the latter being made from the ordinary milk tin.

The plan of operation is as follows :—

(1) The bedpan is brought from the patient and emptied into excreta pail.

(2) Rinse the pan with water, using the dipper. Bedpan must not be placed in box containing water.



(3) Place the pan in cresol solution and mop it out thoroughly, leaving mop in the solution with handle raised. The pan is left resting in the cresol solution until the cleansing of the next pan is required, when it will be removed and placed in the compartment in the lower side of sanitary box. The ultimate disposal of excreta is carried out at the destructor.

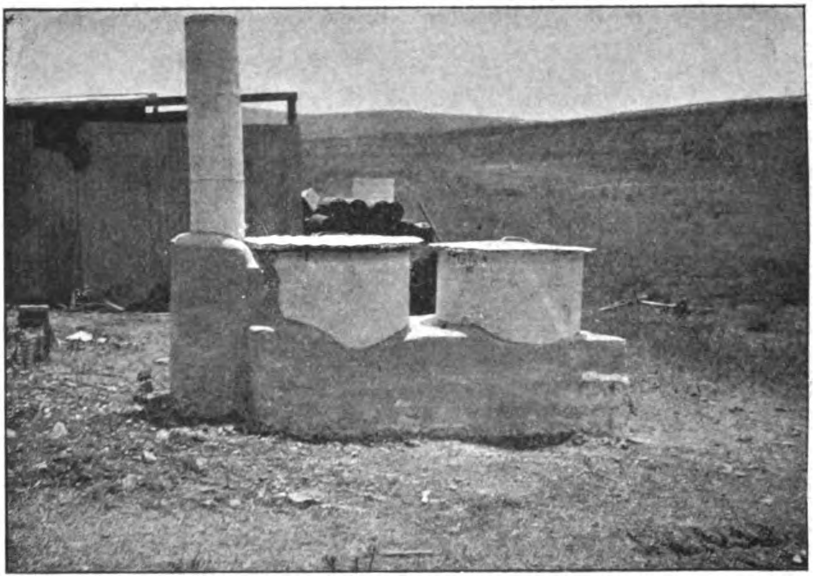
With the latrines placed at the usual distance from the hospital wards it is impossible for the orderlies to deal with the excreta quickly and safely, and this can only be overcome by providing near at hand a means for immediate disposal of the infectious stools.

The destructor is composed of two half sections of the ordinary petrol drum which has an average capacity of 180 gallons. A firebox is

constructed on which rests each section. A hopper lined with tin is placed between these sections and receives the boiled excreta, carrying it down a four-inch drain to a series of pits, measuring 7 by 7 by 7 feet. Three of these pits in line, one communicating with the other, will effectually dispose of fluid stools of 400 patients. The boiled excreta is dipped out into the hopper with a large dipper made from a half section of a cresol tin, to which is attached a long strong handle.

From time to time the boiling process is continued, after the supernatent fluid has been dipped out, until the residue is sufficiently firm to be scraped out and burned in the incinerator destructor.

The following "Directions" are fastened on the inner side of the box cover :—



DIRECTIONS FOR USE OF SANITARY BOX.

(1) Carefully empty bedpan into latrine bucket in middle compartment.

(2) Take one dipper full of plain water from box on the left, hold pan over latrine bucket and carefully rinse it inside and out.

(3) Place the pan in the cresol box on the right, thoroughly swabbing it out with mop and leave it in this solution.

(4) When emptying afterwards, first remove the pan which has been left in cresol solution, rinse it off with plain water and place it in the bedpan cupboard in the lower part of the box, then follow instructions for second bedpan as above.

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THE DISTRIBUTION AMONG FOODSTUFFS (ESPECIALLY THOSE SUITABLE FOR THE RATIONING OF ARMIES) OF THE SUBSTANCES REQUIRED FOR THE PREVENTION OF (*a*) BERIBERI AND (*b*) SCURVY.[1]

(*With Six Figures.*)

BY HARRIETTE CHICK AND E. MARGARET HUME.

(*From the Lister Institute of Preventive Medicine.*)

CONTENTS.

INTRODUCTION.

SUFFICIENT evidence is now available to permit beriberi and scurvy to be classed among the "deficiency" diseases due to a defective diet, without further comment. The view that scurvy is caused by the absence of fresh food, especially vegetables, was

[1] Read at the meeting of the Society for Tropical Medicine and Hygiene on February 16, 1917.

established in popular opinion more than 150 years ago[1] and is maintained to-day, in spite of various attempts—some of which are quite recent, e.g., Jackson and Harley (1900), Coplans (1904)—to suggest and defend a different etiology. The study of beriberi is confined to much more recent times and during the last twenty years has received the attention of many capable investigators. The researches of Eijkman, Grijns, Braddon, and Fraser and Stanton, among others, have proved beriberi among the rice-eating populations of the East Indies, where it is prevalent, to be due to a definite deficiency in the diet of the persons afflicted. The defect was traced to a loss of specially valuable constituents of the rice grain which occurred during milling and polishing after the modern method, and these workers showed that the disease could be prevented if unmilled rice were substituted for milled rice in the diet, or if the bran removed during milling were added to the "polished rice." The later workers on this subject include Schaumann (1910) and Funk (1913), in whose papers a complete bibliography of the subject may be found. To Funk (1912) we owe the expression "vitamine," which he invented to express the unknown essential principle whose absence from a diet occasions beriberi. The term has, however, become established in general use to signify any accessory substance necessary for satisfactory metabolism, deficiency of which in a diet will lead to the occurrence of a "deficiency" disease.

The present position may be summed up as follows: For perfect nutrition the human being requires, in addition to an adequate ration of fat, protein, carbohydrate, salts and water, a sufficient supply of accessory food factors or "vitamines." These substances have not so far been successfully isolated; little is known of their chemical or physical properties, and, at the present time, their presence can only be detected by biological methods. There are at least two[2] distinct classes of these "vitamines": (1) the vitamine, whose presence in a diet is an essential for the proper nutrition of the nervous system, and whose absence or deficiency will give rise to beriberi: for the sake of brevity this may be called the anti-neuritic or anti-beriberi vitamine; (2) the anti-scorbutic vita-

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[1] See James Lind: "A Treatise on the Scurvy," 2nd edition, London, 1757.

[2] Rickets and pellagra and some less known diseases of cattle are also generally classed among the diseases due to defective nutrition; investigation in these cases is, however, not nearly so far advanced as in scurvy and beriberi.

mine, whose absence or deficiency in a diet will occasion scurvy with its characteristic pathological changes.[1]

Scurvy and beriberi are now known to be respectively caused by a deficiency in the diet of these two different classes of "vitamine," which possess different properties, play a different part in metabolism, and are differently distributed among foodstuffs in nature.

Deficiency diseases are practically non-existent among modern civilized Europeans, for, when living upon the ordinary mixed diet of civilization, it is difficult to avoid getting an adequate amount of each separate vitamine. It is where the diet is more simple, as is the case with those of many Eastern races, that the risk of deficiency disease becomes proportionately greater. The food then needs careful scrutiny to ensure that all necessary vitamines should be included in the comparatively few substances of which the diet is composed.

In the case of Europeans, however, a variety of special causes may lead to what is virtually a restricted diet, *quâ* vitamines, although it may not be apparent. Armies on active service, exploration parties in Arctic regions, may enjoy a varied supply of preserved and sterilized foods, but in effect be deprived of vitamines, these being wholly or in part destroyed by the high temperatures and other processes to which the food has been subjected in the course of preparation. Under such conditions beriberi or scurvy may take some months to develop to an acute stage, but there is little doubt that the defective diet will give rise to a general condition of ill-health and inefficiency some time before definite symptoms of these diseases can be diagnosed by the physician. It is clearly of the utmost importance to ensure that a satisfactory diet should be available for soldiers and sailors on active service, more especially when one considers the great strain, both mental and physical, to which they are subjected. The first step towards this achievement is to obtain trustworthy information as to the distribution of these essential "vitamines" in ordinary foodstuffs. Some of this knowledge is already available and it was with the hope of

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[1] The spongy and septic condition of the gums characteristic of scurvy is probably partly, if not wholly, due to secondary bacterial infection. The defences against invasion are well known to be weaker in the mouth than in many other parts of the body and in scurvy are further reduced owing to the abnormal condition of the blood system. This may account for the view frequently advanced, with some experimental support, that scurvy is an infectious disease of bacterial origin.

supplementing the existing data upon the subject that the present work was undertaken.

Experimental.

(1) *Distribution of Anti-Beriberi Vitamines.*

The distribution of the anti-beriberi vitamine among various foodstuffs was made the subject of a special investigation by Cooper (1913 and 1914) working in this Institute. We have used his methods and our endeavour has been to extend his work with special reference to substances which are dry and portable, and hence specially suited to the rationing of troops on active service.

The deficiency polyneuritis of birds which is readily induced experimentally by a diet of polished rice[1] has been accepted as analogous to human beriberi from the similarity of its etiology, symptoms, and method of cure. Cooper chiefly used the pigeon as experimental animal; this bird is specially adapted for the study of the anti-neuritic vitamines, seeing that it is extremely susceptible to polyneuritis, but does not apparently take scurvy, even when deprived of anti-scorbutic material. Our work has also been done with the pigeon, and, following the method of Cooper, we have studied the anti-neuritic properties of a series of foodstuffs by means of the following two types of experiments:—

(*a*) *Preventive Experiments*, in which the aim was to determine the minimum amount of the foodstuff that must be added to a vitamine-free diet, to prevent onset of polyneuritis. Polished rice (forty grammes daily) formed the vitamine-free diet, and prevention was reckoned to be successfully accomplished if the bird showed no symptoms after fifty to sixty days. Unprotected birds usually develop acute polyneuritis after fifteen to twenty-five days.

(*b*) *Curative Experiments*, in which the birds were fed upon polished rice until acute symptoms of polyneuritis were observed. Determination was then made of the minimum amount of the foodstuff in question which would effect a cure when administered by the mouth. Birds suffering from acute polyneuritis will usually die within twenty-four hours if not treated. In order to get the requisite amount of curative material (anti-beriberi vitamine) absorbed in time it was frequently necessary to concentrate the vitamine. To do this a weighed quantity of the air-dry material was extracted

[1] Polished rice is the ordinary smooth white rice of commerce; in the preparation and milling, the pericarp ("silver skin") and embryo are stripped from the grain, which is then polished with talc between sheepskin (see fig. 1 below).

TABLE I.—PREVENTIVE EXPERIMENTS.

Minimum Daily Ration which must be added to a Diet of Polished Rice to prevent Onset of Polyneuritis (Beriberi) in a Pigeon of 300 to 400 grm. weight.

Substance	Daily ration: Natural foodstuff (grm.)	Daily ration: Dry weight (grm.)	Observer	Notes on results
Wheat germ (sample R.I.), free from bran	1·5	1·3	H. C. and E. M. H.	Complete protection
Wheat bran (sample R.I.), free from germ..	More than 1·5	More than 1·4	,, ,,	*No* protection with 1·5 grm. daily; polyneuritis occurred in same time as in control birds
	,, ,, 2·5	,, ,, 2·2	,, ,,	Small degree of protection, mean time of onset delayed about two weeks
Yeast extract, commercial, sample A ..	0·5	0·35	,, ,,	Protection not secured in all cases
	1·0	0·7	,, ,,	Protection
Pressed yeast	2·5	0·5	Cooper, *Journ. of Hyg.*, 1913-1914	—
Lentils	—	3·0	,, ,, ,,	—
Barley, unhusked	3·7	3·2	,, ,, ,,	—
Barley, husked	5·0	4·5	,, ,, ,,	—
Egg-yolk	3·0	1·5	,, ,, ,,	—
Beef-muscle	20	5·0	,, ,, ,,	—
Ox heart-muscle	5	1·7	,, ,, ,,	—
Ox brain	6	1·2	,, ,, ,,	—
Ox liver..	3	0·9	,, ,, ,,	—
Sheep brain	12	2·5	,, ,, ,,	—
Fish-muscle	More than 10	More than 2	,, ,, ,,	Protection not secured with this ration
Cheese	,, ,, 8	,, ,, 5·6	,, ,, ,,	Protection not secured with this ration
Cow's milk	,, ,, 35	,, ,, 3·5	,, ,, ,,	Protection not secured with this ration

TABLE II.—CURATIVE EXPERIMENTS.

Minimum Amounts of Various Foodstuffs required to cure Polyneuritis (Beriberi) in a Pigeon 300 to 400 grm. in weight. The Doses are reckoned in Terms of the Original Foodstuffs.

Substance	Preparation of curative material	Amount of dose given: In terms of the natural foodstuff, grm.	Amount of dose given: In terms of dry weight (dried 100-110°C.) grm.	Result	Observer
Wheat germ :					
Commercial sample, cooked.. ..	Extracted with alcohol..	8	6·9	Improvement ..	H. C. and E. M. H.
		12	10·3	Sometimes cures..	,, ,,
		16	13·8	Cures	,, ,,
Sample A, "picked," uncooked ..	,, ,, ,, ..	10	8·7	Incomplete cure..	,, ,,
		15	13·0	Complete cure ..	,, ,,
Sample B, "picked," uncooked ..	Unextracted	1·0	0.9	Sometimes cures	,, ,,
		2·5	2·2	Cure	,, ,,
*Maize germ**	,, ...	1·0 to 3·0	—	,, ...	,, ,,
*Rice germ**	,, ...	0·5 to 1·0	—	,, ...	,, ,,
Wheat bran :					
Stone ground, not free from germ ..	,, ...	5·0	—	Sometimes cures	,, ,,
Roller milled, free from germ ..	,, ...	3·0	—	No cure	,, ,,
		5·0	—	Sometimes cures	,, ,,
Rice bran, containing germ	,, ...	6·0	—	No cure	,, ,,
		10·0	—	Complete cure ..	,, ,,
Turbot (hard) fish-roe	Extracted with alcohol..	35	10	Cure almost complete	,, ,,
		70	20	Cure complete ..	,, ,,
		140	40	,, ,, ..	,, ,,
Egg-yolk	,, ,, ,, ..	60 (= 4 yolks)	30	Cure	Cooper, 1913
Dried whole egg, commercial, sample I	Given without extraction	40 (= about 4 yolks)	38	,, ...	H. C. and E. M. H.
		30 (= about 3 yolks)	29	,, ...	,, ,,
,, ,, sample II	,, ,, ,,	20 (= about 2 yolks)	—	,, ...	,, ,,

Malt extract:					
First sample	Given without extraction	5	4·2	Cure	Cooper, 1914
Second sample..	,, ,, ,,	7	5·1	,, ...	,, ,,
Third sample	,, ,, ,,	10	9·2	No cure	,, ,,
Meat extract, commercial	,, ,, ,,	3	2·8	No improvement; bird died	H. C. and E. M. H.
,, ,, ...	,, ,, ,,	6·5	5·2	No improvement; bird died	,, ,,
Raw beef	Extracted with alcohol..	140	30 approx.	Cure	Cooper, 1913
"Maconochie" ration	,, ,, ,, ..	440	106	Cure incomplete..	H. C. and E. M. H.
"New ration" roast beef, tinned, submitted for examination by the Department of Hygiene, Royal Army Medical College, June 19, 1916	,, ,, ,, ..	350	112	Very slight improvement; no cure	,, ,,
Dried peas	,, ,, ,, ..	30	26	Incomplete cure..	,, ,,
		40	35	Complete cure ..	,, ,,
,, ...	Unextracted	10	9	Cure	,, ,,
Pea flour, kilned..	Extracted with alcohol..	80	—	Slight improvement; no cure	,, ,,
Dried lentils	,, ,, ,, ..	20	18	Cure	Cooper (1914, I)
Dried vegetables, commercial.. ..	,, ,, ,, ..	40	35	,, ...	H. C. and E. M. H.
Sample, "spring greens"	,, ,, ,, ..	120	105	Complete cure ..	,, ,,
Potatoes, peelings	,, ,, ,, ..	180	36	Died	,, ,,
,, ,, ...	,, ,, ,, ..	630	126	Improvement; no cure	,, ,,
,, insides..	,, ,, ,, ..	200	40	Incomplete cure..	,, ,,
,, ,, ...	,, ,, ,, ..	350	70	Cure	,, ,,
Pressed yeast	Autolysed	2·0	0·4	Cured slowly ..	,, ,,
,, ...	,, ...	3·0 to 6·0	0·6 to 1·2	Cured	Cooper (1914, II)
Yeast extract, commercial, sample A	Given without extraction	1·5 to 2·0	1·0 to 1·3	Complete cure ..	H. C. and E. M. H.
Dried fruits, currants	Extracted with alcohol..	60	50	No improvement	,, ,,
,, ,, ...	,, ,, ,, ..	19	16	,, ,,	,, ,,
,, dates	,, ,, ,, ..	26	21	Slight improvement; death delayed	,, ,,
,, ,, ...	,, ,, ,, ..	26	21	Slight temporary improvement	,, ,,
Proprietary article, white powder, stated to contain vitamines in a concentrated form	Given without extraction	12	—	No improvement; died	,, ,,
		31	—	Temporary improvement	,, ,,

* Picked out from the unmilled grain in the laboratory by hand.

with alcohol by shaking up with alcohol in the cold for some hours. The alcohol was then evaporated at low temperature under reduced pressure and the residue was taken up in a small measured quantity of water. Definite amounts of this watery solution formed the curative doses, but in order to obtain a fairer comparison the amount of the dose was reckoned in terms of the original foodstuff.

In case of cereals and some other materials rich in anti-neuritis vitamine, we gave the curative dose of the original foodstuff without preliminary extraction. By this means we avoided the loss of vitamine due to the process of extraction. This loss was very considerable; see, for example, the case of dry peas (given in Table II) where the curative dose of unextracted material was ten grammes, but that estimated from experiments made with an extract was as high as forty grammes. The original material was administered, without extraction, whenever possible, in order to obtain a better absolute value for the vitamine-content of the foodstuff in the natural condition. The drawback of this method is that absorption is slower and one does not get the swift dramatic cures commonly obtained when the curative principle is given in a soluble form. But if care is taken to see that the animal's crop is empty before administering a cure, digestion will not be too slow to permit of sufficient vitamine being absorbed in time to save the bird.

There is no doubt that the most trustworthy results are obtained from the preventive tests. They are, however, very exacting and laborious, the feeding is artificial, and must be continued for about two months, with daily careful supervision. If the inquiry were limited to this type of experiment its scope would be seriously restricted. In considering the values obtained from curative experiments, allowance must be made for a large margin of error, seeing that it is impossible to control the onset of polyneuritis, so that the type of symptom and the severity of the condition should always be the same at the time of administration of the cure.

The principal data obtained are set forth in Tables I and II, in which also many of the results of Cooper (*loc. cit.*) are included for the sake of completeness. Some of the results given in these tables were anticipated by the workers mentioned on p. 1, but Cooper was the first to make a systematic attempt to obtain a comparative set of values for the different foodstuffs as regards ability to prevent beriberi.

From Tables I and II it is seen that the anti-beriberi vitamine is extremely widespread, and is found present in a greater or less degree in almost every natural foodstuff investigated. The principal

sources of this vitamine are, however, at once seen to be found in the seeds of plants or the eggs of animals, where it is probably stored[1] as a provision for the nutrition of the offspring during the early period of its existence.

From the practical point of view the most important result is the fact that *one of the chief sources of the anti-beriberi vitamine should be in the seeds of plants, including, as this does, the cereals and edible pulses.*

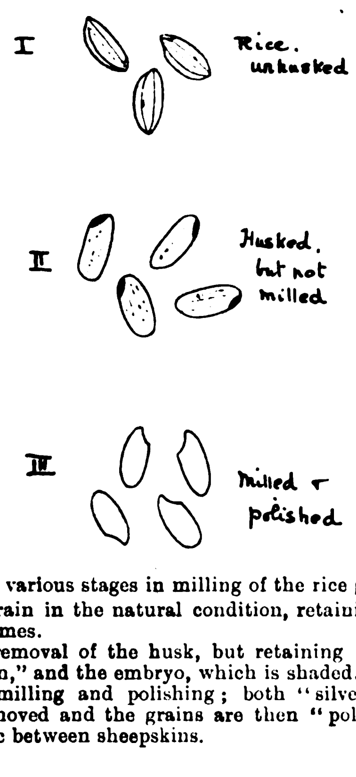

FIG. 1.—Showing the various stages in milling of the rice grain.

I. Rice grain in the natural condition, retaining the husk or enclosing glumes.

II. After removal of the husk, but retaining the pericarp or "silver-skin," and the embryo, which is shaded.

III. After milling and polishing; both "silverskin" and embryo are removed and the grains are then "polished" by rubbing with talc between sheepskins.

The great value of certain beans (e.g., Katjangidjo, *Phaseolus radiatus*) in the prevention and cure both of avian polyneuritis and human beriberi has been repeatedly shown by Grijns (1901), and the other Dutch observers.

[1] It is interesting, in this connexion, to note that among a population upon the verge of beriberi owing to a defective diet, it is frequently the pregnant women who are the first to show acute symptoms (see Vedder, "Beriberi," London, 1913, p. 61).

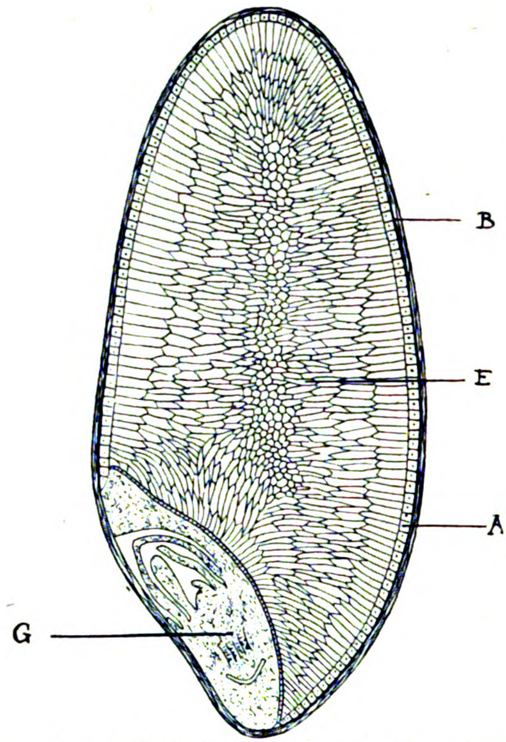

*FIG. 2.—Diagram of a longitudinal section through a grain of wheat, showing :—
B. Pericarp, forming the branny envelope.
E. Parenchymatous cells of the endosperm.
A. Aleurone layer of cells forming the outermost layer of the endosperm, removed with the pericarp during milling.
G. Embryo or germ.

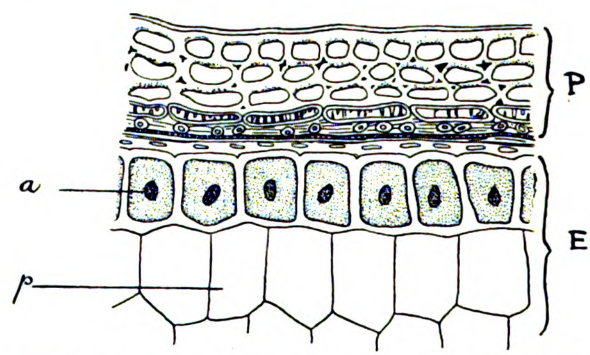

*FIG. 3.—Cross section through the branny envelope and outer portion of the endosperm of wheat grain, showing :—
P. The pericarp.
E. The endosperm, consisting of (*a*) layer of aleurone cells, and (*p*) parenchymatous cells.

* Reproduced, with the permission of the Controller of H.M. Stationery Office, from figs. 1 and 2 in Dr. J. M. Hamill's "Report to the Local Government Board on the Nutritive Value of Bread made from different Varieties of Wheat Flour," 1911.

In the case of cereals[1] an interesting differentiation exists in the different parts of the seed (see figs. 1, 2, and 3), the largest deposit of the vitamine being present in the *embryo*, or germ, while the bran (pericarp + *aleurone layer*) comes second in order of importance. The endosperm (especially when deprived of the *aleurone layer*, which is included in the bran in modern milling) is deficient in antineuritic vitamine, and will cause beriberi if employed as sole diet. One well-known example of a cereal endosperm is "polished" rice (see fig. 1), where the germ is removed with bran during milling and polishing. Another is ordinary white wheaten flour, in the preparation of which a similar deprivation takes place in the modern roller mills. In this case, during the "break" on the rollers, the oily germ is squeezed out flat, and subsequently can be completely separated from the flour and the bran. Both white flour and polished rice produce polyneuritis in pigeons in an exactly similar way and, if the less complete evidence available in case of rye and maize be also taken into account, there is no doubt a general rule that among cereals the anti-neuritic vitamine is concentrated in the germ.

The potency of the cereal embryo in the cure of polyneuritis is very great. In case of wheat germ 2·5 grammes usually (and rarely 1 gramme) sufficed to cure a pigeon of 300 grammes to 400 grammes weight, in an acutely ill condition. In case of rice embryo cures were obtained with amounts varying from 0·5 gramme to 1 gramme.

The prevailing opinion, hitherto, has been that the substance preventing beriberi was situated in the cuticle of the husked grain, in the layer of cells (*aleurone layer*) immediately below the pericarp (see fig. 3). This view is based upon the well-known influence of decorticated rice in inducing human beriberi and the prevention and cure of the disease by the addition of "rice polishings" and their extracts. The true explanation, however, lies in the fact that in the milling and polishing of rice the germ is removed with the bran (see fig. 1). On comparing the values of (1) commercial rice "bran," and (2) the pure germ, separated from the grain by hand in the laboratory, we found the latter ten times as potent as the former for the cure of pigeon polyneuritis.

An interesting analogy with the seeds and embryos of plants is offered by the eggs of birds and fishes—which also form valuable

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[1] A more detailed account of our experiments with cereals is published in the *Proc. Roy. Soc.*, read February 15, 1917 (in the press).

sources of anti-beriberi vitamine. The successful cures obtained with desiccated eggs show the great resistance offered by this vitamine to drying.

Yeast is another substance rich in anti-neuritic properties which it retains even after extraction or autolysis. Yeast was the only unicellular organism investigated, and it may be significant of the universality of this vitamine that it should be abundantly present in this instance.

Milk, cheese, and potatoes appear to be among the least valuable foods from this point of view; other vegetables and meat contained a moderate amount of anti-beriberi vitamine, but are very inferior when compared with eggs or the seeds of plants.

(2) *Distribution of Anti-Scorbutic Vitamines.*

While there is a good deal of empirical knowledge upon this subject, few accurate scientific data are available, and what exist are found chiefly in the work of Axel Holst and his colleagues, Drs. Fürst and Fröhlich, in the University of Christiania (1907, 1912, 1913). By depriving guinea-pigs of fresh green food, and offering only a diet of grain and water, these workers were able to induce a disease analogous to human scurvy, from which the animals died within a month from the commencement of the restricted diet. The post-mortem appearances showed all the lesions typical of scurvy, and included changes in bone, cartilage, and bone marrow, loosening of the teeth, and, in addition, hæmorrhages, which might occur in any situation. These workers studied the influence of various additions to this "scurvy" diet and investigated the distribution of the anti-scorbutic principle among various vegetable foodstuffs and its resistance to drying and to exposure to high temperatures. The commonly accepted view that fresh vegetables and fruits are the chief source of anti-scorbutic vitamine was abundantly confirmed by their experimental work.

No symptoms suggesting beriberi were detected, nor were any nerve lesions discovered in these experimental animals, whose "scurvy" diet of various grains and water included unmilled cereals, and contained abundant anti-neuritic vitamine. In any circumstances the guinea-pig appears to be so highly susceptible to scurvy that attempts to produce beriberi have not been successful. The distribution of the anti-beriberi vitamine is very widespread and on any diet adapted to this animal it seems impossible to protect satisfactorily from scurvy without at the same time supplying a

sufficiency of the anti-neuritic substance. For this reason the guinea-pig is as admirably adapted for the study of scurvy as is the pigeon for that of beriberi.

During the last few months we have extended the work of Holst and his colleagues in the direction of foodstuffs which are portable and convenient for transport and hence suited for the rationing of armies. The methods we have followed have, in principle, been those of the Norwegian workers. The principal modification has been the addition of milk subjected to prolonged heating at a high temperature (120° C. for one hour) to the "scurvy" diet of grain and water. By this addition we have not been able to detect any appreciable change in the special symptoms of the disease or time of onset; but the general condition of the animal is much improved, apart from the scurvy, and the influence of the inclusion of the various anti-scorbutic substances can be studied with less complication from such factors as mere inanition and starvation (see Table III and compare curves A and B in fig. 4).

The experiments have almost invariably been of the preventive type. There is no particular advantage in the curative type of experiment, where scurvy is concerned. The onset of the disease is gradual and by the time the symptoms—loss of weight, painful joints and loosening teeth—are well marked, the lesions are extensive and the animal is in a very weak condition. If, at this stage, a powerful anti-scrobutic, such as orange-juice, is given, the cure is extremely slow and it may be many weeks before the animal may be said to be in perfect health. In fact, it is doubtful whether the joints ever become perfectly normal, and even when the cured animals seemed to have reached a thriving condition, one could frequently detect a slight tenderness of the arm and leg joints by a careful examination.

The general course of these experiments may be seen from fig. 4 and Table III, which give weight charts and brief protocols respectively, of three typical cases.

Experiment 1 (curve A, fig. 4), is a case of typical scurvy on a diet of oats, bran and water. The animal (280 grammes weight), which is in a young and growing condition at the beginning of the experiment, puts on no weight upon this diet. After seventeen days distinct tenderness of the joints is present and from this time the weight begins to decline. After about another ten days the teeth are found to be loose, little food is taken, the loss of weight becomes very rapid and death soon follows. The post-mortem appearances generally found in such cases are as follows:

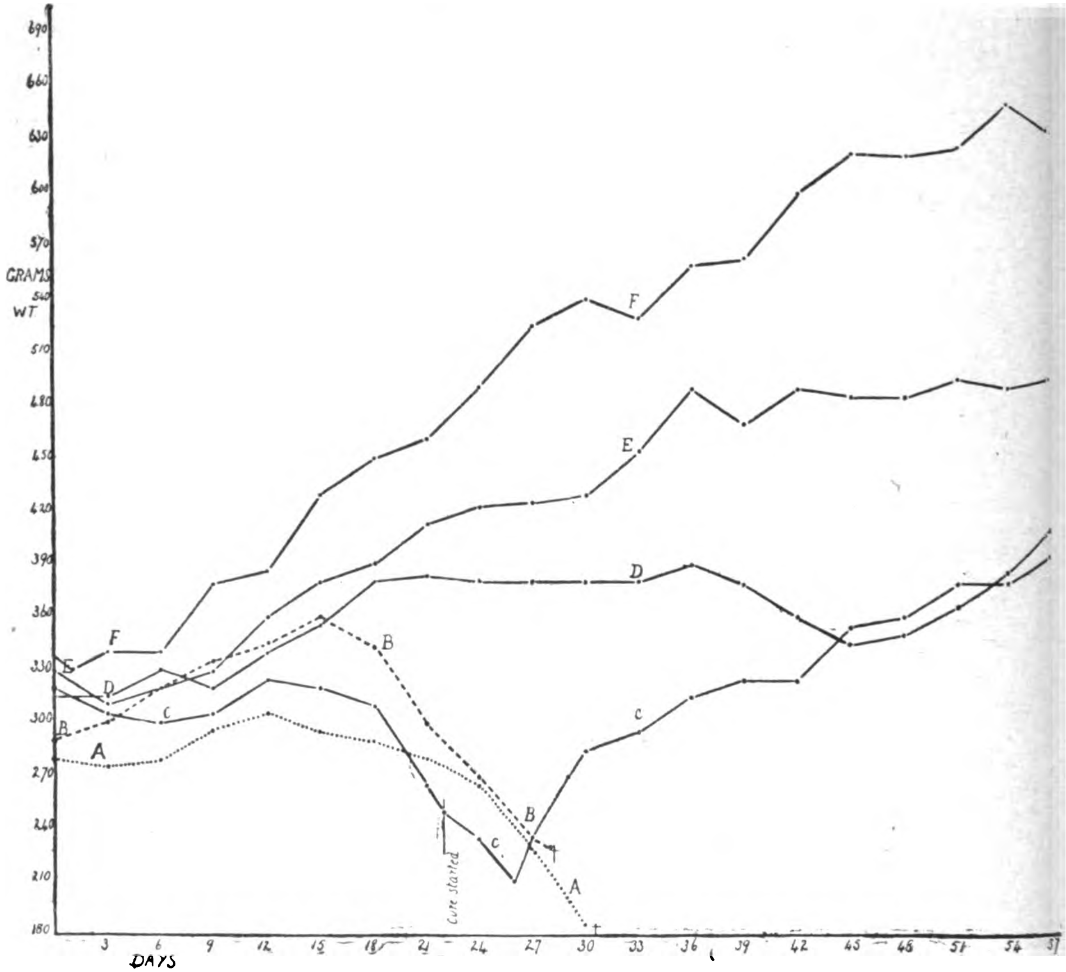

FIG. 4.—Weight charts of five typical experiments showing anti-scorbutic value of orange juice and fresh cabbage leaves.

Curve A. Typical scurvy on a diet of oats, bran and water.

Curve B. Typical scurvy on a diet of oats, bran and sterilized milk (heated to 120° C. for 1 hour in the autoclave).

Curve C. Typical scurvy on a diet of oats, bran and water, cured by addition of orange juice and autoclaved milk to the diet, on the twenty-second day, when symptoms were well marked.

Curve D. Weight chart showing influence of five cubic centimetres fresh orange juice daily added to the "scurvy" diet: autoclaved milk added to the diet on the fifty-sixth day.

Curve E. Normal weight chart on a diet of oats, bran and cabbage-leaves (thirty grammes daily).

Curve F. Weight chart on diet of oats, bran, autoclaved milk and three cubic centimetres fresh orange juice daily; specially favourable circumstances, warm weather, etc.

Extensive hæmorrhages are found present in the muscles of leg and thigh, especially near the knee-joints; less severe ones are frequently found in the muscles of the fore limbs, round the axilla. Sub-

TABLE III.

EXPERIMENT 1.—(Guinea-pig 47.) DIET: OATS, BRAN AND WATER *ad lib.* (See curve A, fig. 4.)

Date	Number of days from beginning of experiment	Condition of the animal	Weight (grm.)		Amount of oats and bran eaten daily, average (grm.)
29.11.16	0	—	280		
16.12.16	17	Leg joints tender	290	(21 days)	34
20.12.16	21	—	280		
25.12.16	26	Leg joints tender; incisor teeth loose ..	240	(9 days)	14
29.12.16	30	Died	185		

EXPERIMENT 2.—(Guinea pig 49). DIET: OATS, BRAN AND AUTOCLAVED MILK (ONE HOUR AT 120° C.) *ad lib.* (See curve B, fig. 4.)

29.11.16	0	—	290	(17 days)	25
15.12.16	17	One leg joint tender	350		
25.12.16	26	Teeth loose..	240	(12 days)	5
27.12.16	28	Died..	230		

EXPERIMENT 3.—(Guinea-pig 58). DIET: OATS, BRAN AND WATER, *ad lib.* FOR TWENTY-TWO DAYS, WITH PRODUCTION OF ACUTE SCURVY; FOLLOWED BY THE ADDITION OF ORANGE JUICE 10 C.C. DAILY, AND AUTOCLAVED MILK (ABOUT 50 GRM. DAILY), LEADING TO A SATISFACTORY CURE. (See curve C, fig. 4.)

6.12.16	0	—	320		
16.12.16	10	One leg sore	315		
22.12.16	16	"Scurvy position" noticed; the sore hind leg is raised in the air while the animal lies down on the other three legs	320	(18 days)	33
24.12.16	18	Great fall in weight begins	310		
28.12.16	22	Animal very weak.. .. .. .. *Cure started:* 10 c.c. fresh orange juice + 50 to 60 grm. autoclaved milk daily added to oats and bran diet	250	(5 days)	10
29.12.16	23	Condition very bad	235		
1.1.17	26	Still very sore	235		
3.1.17	28	Lying in "scurvy" position	270	(10 days)	15
5.1.17	31	Soreness of joints improved	290		
7.1.17	33	—	295		
13.1.17	39	General condition good, joints still sore	325		
24.1.17	50	Ditto ditto ditto	365		
13.2.17	60	Soreness much improved	460	(41 days)	45
21.2.17	68	No symptoms	482		
27.2.17	74	Excellent health, no symptoms ..	540		

cutaneous hæmorrhages are also frequently present, although not to be detected during life, owing to the thickness and pigmented nature of the skin. The bones are fragile and easily break off at

the junction of shaft and epiphysis; this is specially true in case of the tibia, which is often found to be already fractured. The jaws are very brittle and the teeth usually quite loose. There are marked swellings on the ribs at the bone cartilage junction, which is often found to be fractured. On histological examination these junctions are found to be entirely disorganized and to show the characteristic changes in the bone marrow so carefully studied and described by Holst and Fröhlich (1912).

Experiment 2 (curve B, fig. 4) shows very clearly the improved condition when autoclaved milk is substituted for water in the diet, although the course of the scurvy is not modified. Weight is better maintained throughout, and, at the beginning of the experiment, some growth takes place.

Experiment 3 (curve C, fig. 4) deals with a successful cure from scurvy by means of fresh orange juice. The first part of the experiment, on a diet of oats, bran and water, reproduces Experiment 1 very closely. On the twenty-second day, when the guinea-pig is losing weight rapidly, and shows acutely sore joints, orange juice, ten cubic centimetres daily, is added to the diet, and fifty to sixty grammes of autoclaved milk. Little improvement is seen for four or five days and the fall in weight continues. After this, however, a gradual improvement takes place, but it is six to seven weeks after the beginning of the "cure" before the animal may be considered normal. The soreness of the joints persists long after the general health and weight have been restored.

The curves D, E, and F, fig. 4, show the weight curves on diets which give adequate protection from scurvy and are included for purposes of comparison. Curve E shows the increase of weight upon a normal diet of oats, bran and cabbage leaves (thirty grammes daily), and curves D and F show the result of substituting fresh orange juice for the cabbage leaves, with the addition also of autoclaved milk.

It will be gathered that these experiments are laborious and very tedious. The guinea-pigs in most cases require a certain amount of hand feeding to gain assurance that the requisite doses of the materials studied are really taken and much care is also needed to render the foodstuffs palatable, for many of these studied are far removed from the natural food of this animal, and different treatment is required in each separate case. Further, a good deal of skilled attention is necessary if the general health and weight of the animal is to be maintained, apart from the question of scurvy. Under these circumstances the output of work possible from any

one worker is limited and we have been fortunate in obtaining the assistance of the following workers, to whom, in conjunction with ourselves, the investigation of the following foodstuffs has been entrusted :—

Miss Ruth Skelton (fresh and dried vegetables and lime juice).

Dr. E. Marion Delf and Miss Olive Lodge (fresh fruit juices, pulses, soaked and germinated).

TABLE IV.—VALUE OF FOODSTUFFS AS PREVENTIVE AGAINST SCURVY AND BERIBERI.

— signifies not investigated.

Foodstuffs	Water-content (approx.) per cent.	Value against beriberi	Value against scurvy
Cereals—			
Whole grain (wheat)	10 to 13	++	0
Endosperm {polished rice, white flour(wheat)		0	0
Bran .. {e.g., rice, ,, wheat		++	0
Germ or embryo {e.g., rice, ,, wheat		+++	0
Pulses—			
Whole (in dry condition)	12	++	0
Germinated Pulses (or Cereals) ..	50	++	+++
Vegetables—			
Potatoes	80	0	++
Fresh.. .. {e.g., cabbage, ,, onions, ,, carrot	90	+	+++
Desiccated vegetables	10 to 15	+	+ to 0 (according to age)
Pickled, e.g., cabbage	—	—	0
Fruit Juice—			
Fresh.. .. {e.g., orange, ,, lemon	90	—	+++
Eggs—			
Fresh..	70	++	—
Desiccated	6	++	0
Meat—			
Fresh..	70	+	+
Tinned		0	0
Milk—			
Cow's (fresh)	87	0	+ (slight)
Yeast—			
Pressed (autolysed)	77	+++	0
Yeast—			
Extract (commercial sample A) ..	30	+++	0

Our endeavour is to obtain accurate quantitative figures expressing the relative anti-scorbutic value of a large range of different foodstuffs. The work is at present incomplete, but enough information is available from our own results and those of the

Norwegian workers (confirmed throughout by our own), to construct Table IV, in which a rough estimate is given of the comparative value of the various substances in the prevention of (*a*) beriberi and (*b*) scurvy.

It is at once evident that the distribution of the anti-scurvy vitamine is much more restricted than that of the anti-beriberi vitamine. There are here no special places where deposits are found of highly concentrated anti-scorbutic material, but it is present in all living (actively metabolic) tissues of plants and (to a much less degree) those of animals.

The anti-scorbutic principle has not been found present in dried vegetables or in any dry seeds, such as cereals or pulses, diets of which form the classic means of producing the disease of scurvy. *If, however, these seeds are moistened and allowed to germinate, the anti-scorbutic principle is created anew with the beginnings of active cell life.* As far as our present knowledge goes, the presence of the anti-scorbutic vitamine is always associated with living tissues in which active metabolism is taking place. When viable seeds are in the dry, resting condition, all the *active* processes concerned with life and metabolism are temporarily suspended and a disappearance of the anti-scorbutic principle accompanies this cessation. If the seed is moistened, rapid absorption of water takes place, the cells once more become turgid and the active processes associated with germination and growth will begin within a few hours. Accompanying this new activity the anti-scorbutic vitamine makes its appearance in the tissues and gradually increases in amount.

These facts were first discovered by Fürst (1912) and have been amply confirmed by ourselves and our colleagues in an exhaustive set of experiments with peas (*Pisum sativum*) and lentils (*Lens esculenta*) (see fig. 5). Our method has been to soak these seeds in water for twenty-four hours, during which time they absorb their own weight of water. They are then loosely packed in a glass funnel and maintained in a moist atmosphere for one to two days longer, care being taken to ensure abundant access of air. After forty-eight hours at laboratory temperature (50° to 60° F.) the radicle is usually from 0·5 to one cubic centimetre in length (see fig. 6), and at this stage we have used the germinated seeds in our experimental diets. Our work is not yet sufficiently advanced to permit of a final statement of the anti-scorbutic value of these germinated pulses in terms of fresh vegetables, but we have obtained complete protection from scurvy with a daily ration of five grammes, which

indicates a vitamine content comparable with that, for example, of fresh cabbage leaves.

Fruit Juice.—Fresh fruit juices are exceedingly rich in anti-scorbutic vitamine. Holst and his co-workers pointed out the value of fresh lemon and fresh raspberry juice in preventing experimental scurvy, and our researches have chiefly been made with orange and lemon juice. With these latter we have also been able to effect satisfactory cures from an acute scorbutic condition.

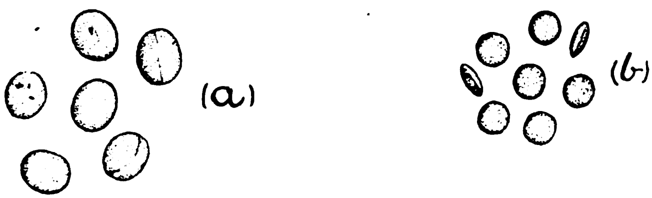

FIG. 5.—Pulses in the dry condition (natural size).
(*a*) Peas (*Pisum sativum*).
(*b*) Lentils (*Lens esculenta*).

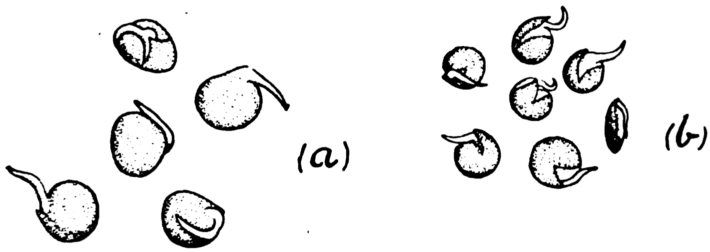

FIG. 6.—Same pulses as in fig. 5 after soaking in water for twenty-four hours, and germination for forty-eight hours at laboratory temperature (natural size).
(*a*) Peas (*Pisum sativum*).
(*b*) Lentils (*Lens esculenta*).

The results of our experiments with preserved fruit juice—e.g., lime juice—have not been so encouraging; the anti-scorbutic power being very feeble in comparison with fresh juices. We are now investigating various methods of preservation in the hope that we may be able to suggest improvements. After reading the history of our Navy and Mercantile Marine it is impossible to resist the conviction that, in former times, preserved fruit juice was of distinct value in preventing human scurvy, and it is not unlikely that modern methods of manufacture may have introduced some modification detrimental to the anti-scorbutic principle originally contained.

Fresh Vegetables.—Among the fresh vegetables investigated,

the cabbage was found best, partly, no doubt, because fresh green leaves happen to be the natural food of our experimental animal. Onions were also found to be powerfully anti-scorbutic, in spite of the dry appearance from the outside. Ordinary Spanish onions contain ninety-five per cent of water, the cells are all in a turgid condition, and, botanically, the vegetable is to be regarded as a live bud. Potatoes and carrots must also be regarded as composed of live turgid tissue; they are also of great value, though found to be slightly inferior to cabbage leaves. In our experiments the potatoes were boiled before giving to the animals and doubtless there was some loss of the anti-scorbutic principle during the process of cooking. It was however a necessary measure, as guinea-pigs are not able to take potatoes in the raw condition.

Milk.—Cow's milk possesses very low anti-scorbutic value. In our experience a daily ration of fifty grammes daily was insufficient to protect guinea-pigs from scurvy. Fröhlich (1912), however, found that they could be protected by an exclusive diet of milk, and we have found the same result if a minimum of 100 grammes is taken daily. This is about twenty times the necessary daily ration (five grammes) of fresh cabbage or germinated peas, or fresh fruit juice. It seems probable that infants nourished on cow's milk do not obtain any excess of anti-scorbutic principle, especially if the milk is previously boiled. The modern custom of adding a small daily ration of fresh fruit juice or other anti-scorbutic appears to have sound scientific foundation.

Meat.—It is practical experience, obtained especially from the history of Arctic exploration, that fresh meat will prevent human scurvy if taken regularly in fair quantity. The expressed juice of raw meat is also considered to be of value in the cure and prevention of infantile scurvy. For prevention of experimental guinea-pig scurvy, meat was found to be very disappointing, for little, if any, protection could be demonstrated. It must be remembered that meat is an unnatural food for guinea-pigs; they will not eat it, even when cooked, and the experiments have to be made with the expressed juices. Allowance must also be made for the high susceptibility to scurvy of this animal, which is undoubtedly much greater than that of the human being; but, when all this is taken into account, one is forced to conclude that meat is far inferior as an anti-scorbutic to vegetables and fruit and that the daily allowance must be large if reliance is to be placed upon it for the prevention of scurvy (see also below, p. 152).

Yeast.—Yeast extract A and autolysed yeast, both of which

were shown to contain the anti-beriberi vitamine, in high concentration, uninjured by the process of preparation, were found useless for the prevention of scurvy. Animals receiving as large a daily ration as could conveniently be taken, died of acute scurvy in the same period as the control animals on the "scurvy diet."

RESISTANCE OF THE ANTI-BERIBERI AND ANTI-SCORBUTIC VITAMINE RESPECTIVELY WHEN EXPOSED TO DRYING, HIGH TEMPERATURES, ETC.

(*a*) *Drying.*—From the common presence of the anti-beriberi vitamine among dry foodstuffs it is evident that this substance is not sensitive to the process of drying. It is very significant that its chief sources should be found in dry seeds, such as cereals and pulses.

The case is otherwise with the anti-scorbutic vitamine. This principle seems to be *absent or deficient in all dry foodstuffs*, such, for example, as cereals and pulses, and to be rapidly destroyed when the animal and vegetable tissues, in which it is naturally contained, are subjected to drying. Holst and Fröhlich (*loc. cit.*) found dried vegetables of little use for the protection of guinea-pigs from scurvy, and we have confirmed their observations. A similar result has been noted in human experience. Dried vegetables were found useless in the epidemic of scurvy which ravaged the Austrian army in Hungary in the early part of the 18th century (Budd 1840), and, including dried potatoes, were tried with the same disappointing result during the American Civil War ("Medical History of the War of Rebellion," vol. iii, Washington).

The temperature at which the tissues are dried seems to be a matter of indifference. In Holst and Fröhlich's experimental work (1912) low temperatures were employed, not exceeding 37° C. The destruction of the anti-scorbutic principle during and after drying, appears to be a gradual process of spontaneous decomposition, which follows disorganization of the living cells in association with which it is produced. If the tissues are rapidly brought to an absolutely dry condition, this process of destruction is checked and the anti-scorbutic properties are preserved to a much greater degree (see Holst and Fröhlich, 1913). In a similar way these workers found that the expressed juices of acid fruits showed more stability in respect of their anti-scorbutic value than those of fresh vegetables, and concluded that the rate of this spontaneous decomposition of the vitamine was slowed by the presence of an acid medium.

This affords some scientific foundation for the general belief that preserved fruit juices may be relied upon to retain some, at least, of their original anti-scorbutic value.

(*b*) *High Temperatures.*—There are many isolated observations upon the influence of exposure to high temperatures upon the anti-beriberi vitamine, but no one hitherto has attempted any systematic study of this point. Grijns (1901) found that one to two hours' exposure to 120° C. destroyed the protective powers of unmilled rice; " Katjanjidgo " beans *(Phaseolus radiatus)* and buffalo meat against avian polyneuritis. Eijkman (1906) and Schaumann (1910) confirmed Grijns' results on the whole, though the former observer found a greater resistance present in case of horse-flesh. Holst (1907) detected no particular loss of anti-neuritic vitamine after exposure of dried peas and unpeeled barley to 115° C. for half an hour, but some damage in case of beef after half an hour at 110° C. Most observers have failed to find any significant destruction of this vitamine at 100° C.

The discrepancy between the results of these various experiments is to be explained partly by the roughness of the biological test for the presence of the vitamine in question. It is also partly due to the fact that certain substances originally containing a low concentration of this vitamine (e.g., meat) may be unable to protect from or cure polyneuritis after a certain degree of exposure to high temperatures, whereas others originally richer in this material (e.g., pulses, cereals, etc.) may, after a similar exposure, yet retain sufficient amount to afford satisfactory protection or cure. Another point to be considered in these experiments is that the temperatures noted appear to be those registered by the autoclave or steamer in which the heating was done and that no measurements are recorded of the temperatures in the interior of the substances heated. This is an important point as the latter temperatures remain for a long time below the former and the degree of difference, depending on the conductivity of the material heated, will vary with every type of substance investigated. It therefore seemed to us worth while to make a series of systematic experiments on this point, and a brief résumé of the results obtained[1] is set forth in Table V.

Two substances were chosen for the investigation, both rich in anti-beriberi vitamine, viz.: (*a*) the germ *(embryo)* of wheat, and (*b*) yeast extract A.

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[1] This work is given in detail, with full protocols of the individual experiments, in a special communication upon the subject to the Royal Society, read February 15, 1917 (in the press).

TABLE V.—INFLUENCE OF EXPOSURE TO HIGH TEMPERATURES UPON THE ANTI-BERIBERI VITAMINE CONTAINED (*a*) IN WHEAT EMBRYO AND (*b*) IN YEAST EXTRACT.

Substance	Temperature Deg. C.	Time, minutes	Minimum amount required to cure a pigeon (300–400 gm.) suffering from acute polyneuritis. (Grammes)
Wheat embryo, water content 11—14 per cent.	unheated	Control	1·0 to 2·5
	98—103	120	2·5
	100—117	40	5·0
	118—124	120	10·0 did not cure
Yeast extract A, water content 30 per cent.	unheated	Control	1·5—2·0
	100	60	2·0—3·0
	122	60	2·5—3·0
	122	120	about 5·0

The data in columns 2 and 3, as to the temperatures reached and the times of exposure, refer to the internal temperatures of the material heated, and were compiled after making a special set of control experiments for the purpose. The vitamine content of the different samples was estimated by determining the minimum amount necessary in the various cases to cure acute polyneuritis of pigeons brought on by an exclusive diet of polished rice. The results in Table V show that the anti-neuritic properties of wheat-germ and yeast extract are only slowly impaired by prolonged heating at or near 100° C., but that destruction is much more rapid at temperatures in the neighbourhood of 120° C.

The experiments at 100° C. were divided to be comparable with the ordinary processes of cooking, while those at temperatures from 110° C. to 120° C. were arranged to throw light upon the probable fate of anti-neuritic (anti-beriberi) vitamines during the sterilization of tinned foods, such as tinned meat, etc. In this connexion it is interesting to compare the curative values given in Table II of—

(*a*) Raw beef, where the curative dose was an extract equivalent to thirty grammes dry weight of the original, and

(*b*) "Maconochie" ration and "New Army" ration, where an "incomplete cure" and "no cure" were obtained with extracts equivalent to 106 and 112 grammes dry weight respectively.

The destructive influence of high temperatures upon the anti-beriberi vitamine is also seen by noting the superior curative properties of dried peas (unheated) compared with "kilned" pea-flour.[1]

[1] This fact needs emphasis since many samples of pea-flour on the market are kilned in the process of preparation, although no mention of this fact is made on the wrapper, etc.

As was the case in exposure to drying, so in exposure to high temperatures, the anti-scorbutic vitamine appears to be much more unstable than the anti-beriberi vitamine. There exists no systematic experimental work upon this point, and we are now starting a series of experiments with the hope of filling the gap. There are, however, some valuable observations of Holst and Fröhlich (1912), all of which point to the greater sensitiveness of this vitamine to high temperatures. When cabbage leaves were boiled at 100° C., the results obtained indicate that at least one-half of its anti-scorbutic value was lost in thirty to sixty minutes, and after heating to 120° C. for sixty minutes almost *all* power of protection against scurvy was destroyed (*loc. cit.*, Table IV, B, p. 70).

In the light of these results it is not to be expected that anti-scorbutic vitamine will survive the heating to which tinned foods are subjected in order to render them sterile.

Practical Application of the Experimental Work to the Prevention, respectively, of Human Beriberi and Human Scurvy.

The practical use that can be made of these investigations on the distribution of the two classes of essential vitamines will depend on the identity of avian polyneuritis and human beriberi on the one hand and of guinea-pig scurvy and human scurvy on the other. As regards etiology, nature of symptoms and method of cure, the analogy in both cases is so perfect that they can be considered as physiological equivalents and the information thus acquired can be applied forthwith.

There is, however, in addition, a great deal of direct evidence to be extracted from human experience. The individual instances may not seem to be altogether conclusive, but when taken together they form a mass of evidence which is very impressive and afford a striking confirmation of the results obtained from experimental work. To exhaust these instances would need a very long communication. We propose, however, to describe briefly a few cases which seem to us among the more instructive.

Prevention of Beriberi.

Importance of the Nature of the Cereal Food in the Prevention of Human Beriberi.—In almost all cases human beriberi is to be attributed to a defect in character of the cereal employed in the diet.

The best known and best studied case is that of the rice-eating

populations in the Dutch Indies, Malay States, the Philippine Islands, etc.; it has been the subject of numerous series of researches, among which those of Eijkman, Grijns, Braddon, Fraser and Stanton, Vedder and Chamberlain are among the more important. All these workers are agreed that disease is caused by a defect in the rice taken, which defect can be traced to the complete decortication which takes place in the modern steam-milling of the grain. Beriberi is prevented in cases where unmilled rice is substituted for the "polished" rice, or where the bran ("polishings") removed in the milling is added to it. The general opinion is that the anti-beriberi vitamine is contained in the inmost layer of cells (*aleurone layer*) of the skin, which layer of cells is removed with the bran in the process of preparation. Our experiments indicate that the *germ (or embryo) of the grain, also removed during milling, is the principal source of the anti-neuritic vitamine,* though it is present also in the bran (see Table II). It is not so generally realized, however, that the same principle applies to other cereals, or that an equal danger of beriberi is to be apprehended for a wheat-eating population under certain circumstances. In the modern "roller" milling of wheat there is complete separation of bran and germ from the flour; unless, therefore, these constituents are purposely included later (as in brown flour and "standard" flour) one may regard ordinary white flour and the bread or biscuit baked from it as being free from these valuable constituents.

The deficiency of anti-neuritic vitamine in white wheaten flour was shown by Holst (1907), Edie and Simpson (1911) and also by ourselves (see footnote, p. 131), to occasion polyneuritis in pigeons in a manner exactly similar to polished rice. The following three incidents show that these results are also applicable to the case of beriberi in man. Under ordinary circumstances this deficiency of vitamine in white bread is well supplied in the other articles of the usual mixed diet of the European. It is in cases where extremes of climate restrict the variety of available foodstuffs, or where there is temporary separation from fresh food supplies on long sea voyages or by the exigencies of active service on long campaigns, that this defect in the bread ration may become apparent in a tragic manner.

(1) Little (1912) states that in Newfoundland and Labrador, where in mid-winter and spring many persons are obliged to subsist largely on bread, beriberi frequently occurs. At the present time the bread is made from fine white wheat flour; in the memory of the older inhabitants, when the bread was made from "brown" flour, the disease was unknown. In 1910 the following interesting event

took place. A ship laden with whole-wheat flour ran ashore and a considerable proportion of her cargo was removed in order to lighten her, and later was consumed by the adjacent population. There was no case of beriberi in that region for a year following this occurrence.

(2) Beriberi was rare on Norwegian ships before 1894, after which date it became much more frequent. This frequency coincided with an alteration of diet which was made compulsory in that year in response to a popular demand for an "amelioration" of the conditions of life in the Norwegian mercantile marine. Previously the sailors on long voyages used biscuit made from rye flour; subsequently, the masters of ships were obliged to supply bread baked from white wheaten flour or a mixture of wheat and rye flour (Holst, 1911). It is an interesting corollary upon our experimental work to note that *in the milling of rye flour there is no separation of the germ.*

(3) The most impressive case of all is to be found in the experiences of our own troops recently operating in Mesopotamia. In his "Account of the Medical Arrangements, etc., during the Siege of Kut-al-Amara (December, 1915 to April, 1916), Colonel Hehir, I.M.S. (1917) states: "In the early stage of the siege a recrudescence of beriberi amongst British troops gave rise to some apprehension, *but it then disappeared;* whilst in Indian troops and followers during the latter half of the siege scurvy caused anxiety." From other entries in this vivid and valuable diary it is seen that the British troops in the garrison received a cereal ration of wheat flour during the first two months of the siege. After February 5, 1916, from one-third to one-half of this flour was replaced by barley flour and by "atta," the coarsely-milled wheat usual in the Indian sepoy's ration. It is very significant that beriberi should have broken out among the British troops while upon their normal ration of white wheaten flour and should have cleared up when they were obliged to share in the more coarsely-milled (and doubtless germ-containing) grain of their Indian fellow-soldiers. There is no doubt, from the wealth of detail given in Colonel Hehir's report, that the British troops were protected from scurvy by the ample daily rations of meat[1] (twelve ounces at first, later,

[1] This meat appears to have been fresh, except possibly between dates of December 30 and January 29. Fresh meat has some protective power against beriberi, but this is slight compared with that of grain and pulses. It would be of great interest to know whether, during the outbreaks of beriberi among British troops, prior to the siege of Kut (Colonel Hehir speaks of a "recrudescence" during the siege) the men were receiving tinned or fresh meat.

January 22, 1916, eight ounces), or horse-flesh (1¼ pounds March 4, 1916) served out to them throughout the siege. The Indian soldiers, while protected from beriberi by the nature of their cereal ration, failed, in many cases, to obtain a sufficient supply of anti-scorbutic vitamine, owing to their refusal to eat fresh meat, in spite of the admirable and persuasive manifesto issued by Colonel Hehir upon the subject.

During the whole operations in Mesopotamia the Indian soldier seems to have been well protected from beriberi. This was to be expected, for, in addition to an unspoilt cereal, he normally gets a generous daily ration of *dhall*, consisting of various dry pulses, which, as may be seen from the foregoing work, are also valuable sources of anti-beriberi vitamine. These, however, did not afford protection from scurvy, which was specially prevalent among the Indians, for example, in the summer of 1916, when, presumably, great difficulty was experienced in providing fresh fruit and vegetables (Mesopotamia Report, x, 42).

The deduction to be drawn from all this experience is as follows: *For the prevention of beriberi it is in the highest degree desirable that the germ (embryo) and the bran of wheat should not be excluded from the flour destined for manufacture of bread and biscuit for troops on active service.*[1] *This is the more necessary when the troops are separated from fresh food supplies and the rest of the rations consists largely of tinned foods, seeing that these articles are deficient in* all *vitamines owing to their previous sterilization at high temperatures.*

Yeast and Yeast Extract.—Yeast is acknowledged to be a most valuable source of anti-neuritic vitamine. There is not much evidence at present available as to the value of yeast and yeast extracts in the prevention of human beriberi: we have not been able to find any report of such a trial. Ordinary dried yeast is very disagreeable to take and causes digestive disturbance, but many yeast preparations possess none of these defects. They have the agreeable savoury taste of a meat extract, and are largely used as an ingredient in certain soup cubes on the market. We have examined

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[1] In packing and transporting whole-meal or germ-containing flours extra precautions are usually considered necessary to protect from damp, and the advice of experts should be sought upon these points. No possible difficulty could arise in case of biscuit baked before transport; certain samples have been specially investigated by us and were found to be entirely satisfactory for the prevention of beriberi.

one of the principal commercial yeast extracts (Yeast extract A, Tables I and II), and could detect no loss of the original vitamine of the yeast, owing to the method of preparation. Soup squares form at all times a very popular addition to the soldier's ration and might well be limited to those containing a certain proportion of yeast extract, seeing that pure meat extracts have been found deficient in anti-beriberi vitamine (see Table II). By such a measure a valuable extra supply of anti-beriberi vitamine could be added to the ration in a very convenient and palatable form.

Dried Eggs.—It will be seen from the examination of two commercial samples of desiccated eggs given in Table II, that so valuable an article of diet as the fresh egg can be successfully dried without losing its anti-beriberi properties. Dried eggs may prove too expensive to form any part of the ordinary soldier's or sailor's dietary, but there can be no doubt as to their suitability for inclusion in hospital stores. Intestinal infections form a large part of the medical casualties in armies on active service, especially when operating in hot climates, and during both the acute stage and the convalescence the diet is usually restricted to tinned milk and invalid foods, all of which may be regarded as vitamine-free. Mention is made below of the possibility that intestinal infections may in some cases prove a predisposing cause of deficiency disease. It is therefore highly desirable that all supply of vitamine should not be cut off during such an illness. Fresh eggs, which provide anti-neuritic vitamine, and are also well suited for an invalid diet, are seldom obtainable, and we would therefore strongly recommend that dried eggs should be freely used as a substitute. Both commercial samples examined by us were found to be very rich in antiberiberi vitamine; they were soluble and could be taken raw, and if cooked they made excellent and very palatable dishes.

Prevention of Scurvy.

It is a platitude that scurvy can be prevented by the inclusion of fresh vegetables and fruit in a dietary. These are frequently impossible to obtain under the conditions of active service. It is therefore our intention under this heading to treat only of such substitutes as are convenient for transport, and hence suited to the needs of armies in the field.

Germinated Pulses as a Substitute for Fresh Vegetables.—The most important fact that has emerged from the study of experimental scurvy is the discovery of Furst (1912) that the anti-

scorbutic vitamine, absent or deficient in the resting seed, makes its appearance in the early stages of germination. In our own experiments with peas and lentils, these were first soaked in water for twenty-four hours, the temperature ranging from 50° to 60° F.; at this stage a small amount of anti-scorbutic vitamine could already be detected. After germination for a further forty-eight hours, with access of air, the vitamine-content had increased five to six-fold, and at this stage the germinated material may be considered the equal of fresh vegetables as regards its anti-scorbutic value (see Table IV, above).

It is difficult to imagine any circumstances in which this form of anti-scorbutic food could not be made available. In the dry form, peas, beans, lentils, and other pulses contain only ten to fifteen per cent of water and are eminently suited for transport. They are commonly included in the active service dietaries of armies, and in the case of Indian troops as *dhall* form a considerable proportion of the daily ration. The only change needed is that these pulses should be issued in the unmilled (not husked or split) condition and should retain the original seed-coat. Then, in case of unavoidable shortage of fresh fruit or vegetables, a substitute could be made immediately available on the spot by germinating the pulses included in the stores.

The whole operation consists of a preliminary soaking, in which the seeds absorb over 100 per cent of their original weight of water, followed by subsequent germination; after this the food should be cooked and eaten as soon as possible. The time taken by the complete operation could be reduced to thirty-six hours in a hot climate. In the Appendix, p. 158, a set of directions is given which may be found a useful guide for preparing these germinated pulses in the field.

It is very important that the peas, lentils, etc., should be cooked and eaten as soon as possible after germination, and should not be allowed to dry again. In the process of drying, the anti-scorbutic vitamine developing during the germination will again be destroyed. Having regard to the sensitiveness of this vitamine to high temperatures it is also important that the pulses should not be cooked longer than is necessary to render them soft and palatable. A period not exceeding one to one and a half hours should suffice for peas and about half an hour for lentils. No deterioration in flavour can be detected after germination has taken place.

Dry pulses contain a high proportion of anti-beriberi vitamine

and this was found by Grijns[1] (1901) to be lessened in amount as germination takes place. We found that in the early stages of germination an abundant supply of anti-beriberi vitamine was still retained by our peas and lentils. Dramatic cures of pigeons with acute polyneuritis were obtained with moderate doses (five to ten grammes) of peas and lentils germinated to the stage shown in fig. 6, at which we were using them successfully for the prevention of scurvy.

Germinated pulses and cereals[1] therefore occupy a special position among foodstuffs in being richly endowed with both the anti-scurvy and the anti-beriberi vitamine.

Vegetables.—Among vegetables the onion is marked out as being specially suited to the needs of troops, owing to its great resistance to adverse conditions during transport and to the length of time it will remain wholesome. The anti-scorbutic value is comparable with that of fresh cabbage and its flavour gives it more value as a culinary adjunct than is possessed by any other vegetable.

Potatoes were found to be somewhat inferior in anti-scorbutic properties to cabbage, onions, etc. They are more suitable for transport and keep better than most vegetables and there is no doubt that they have been proved of great value for the prevention of human scurvy. It must be remembered however, that the amounts consumed are rather large. In one Irish workhouse[2] the daily ration of potatoes is three pounds; after a careful study of convict diets, Dr. Guy[3] concluded that fourteen ounces daily would protect from scurvy, the rest of the ration including one ounce of other fresh vegetables and four ounces of meat. Outbreaks of scurvy have repeatedly followed failure of the potato harvest in countries where potatoes are a staple article of diet, e.g., Norway

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[1] Captain Cook, whose long voyage (1772-1775) was notable for the continued good health of the sailors, always took with him a large supply of malted barley. He had the greatest belief in the anti-scorbutic value of a freshly-made infusion (sweetwort) and served it out to his men in case of need ("Captain Cook's Voyages," Everyman Edition, p. 227).

Some Chinese are accustomed to take part of their daily rice in the germinated condition and this custom has spread to the Malay States (private communication from Brigadier-General Anderson), and Dutch Indies (Grijns, 1910), where "Towgay" or germinated pulses are regularly taken. There appears to be no evidence, however, that the anti-scorbutic properties of these foods has been appreciated.

[2] Limavady Union, Co. Derry.

[3] Dr. Guy's evidence, Report of the Lords Commissioners of the Admiralty on the Outbreak of Scurvy in the recent Arctic Expedition, 1877, para. 5323.

in 1904 (Holst and Fröhlich, 1912), and Ireland in 1847 (Curran). The recent appearances of scurvy in Glasgow,[1] Newcastle[2] and Manchester is no doubt to be attributed to the great scarcity of potatoes during the last three or four months.

Fresh Meat.—The expressed juices of fresh meat gave disappointing results in the prevention of guinea-pig scurvy, but there is no doubt that human beings can be protected by its regular use. This is one of the cases which suggest that the guinea-pig is much more susceptible to scurvy than is man, an opinion also held by Holst and Fröhlich (1912). Many clinicians believe fresh meat juice to be capable of curing infantile scurvy, and in many Arctic expeditions, where scurvy has been escaped, fresh meat of various kinds has been the only anti-scorbutic material present in the diet.

The following incidents are related by Jackson and Harley (1900):—

Six Russian priests spent the winter in a hut at Kharborova, Yugor Straits, with a small Russian boy to wait upon them. Their religion would not permit them to eat reindeer or such meat; they subsisted largely on salted fish and there were no vegetables. In the following May the little Russian boy was found to be the only surviving person in Kharborova; he was subject to no religious restriction and ate reindeer meat during the winter. Jackson, himself living among the Samoyads in Waigatz, 1893-1894, noted that among those of the population who winter on the island and do not get vegetables or lime-juice, but live largely on fresh reindeer meat, scurvy is unknown. Some Samoyads, however, migrate with Russian peasant traders and spend the winter near the large rivers in north-east Russia, where the diet consists largely of salt fish; among these scurvy is prevalent.

There is no doubt, however, that animal tissues are distinctly inferior in anti-scorbutic properties to those of fresh fruit or vegetables, and that a large and regular ration is necessary for safety. This opinion was expressed by many witnesses in the Admiralty inquiry[3] upon the outbreak of scurvy in the Arctic Expedition of 1875, and in the older literature many instances occur in which an apparently liberal meat ration did not prevent scurvy. Curran (1847) describes three cases admitted to Swift's

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[1] *Lancet*, July 8, 1917.

[2] Harlan, *Brit. Med. Journ.*, July 14, 1917.

[3] Report of the Lords Commissioners of the Admiralty upon the Outbreak of Scurvy in the recent Arctic Expeditions, London, 1877.

Hospital, Dublin, in the great Irish epidemic of 1847, where the previous diet had included ¾ pound of meat on five days of the week.

Colonel Hehir[1] in a report suggesting needed reforms in the Indian soldiers' diet in Mesopotamia as early as April, 1915, expresses great doubt whether the authorized meat ration of twenty-eight ounces weekly is sufficient to prevent scurvy unless more meat is added and the vegetable ration (two ounces potatoes) is increased. If dry weight is taken into account in comparing the anti-scorbutic value of meat and vegetables, four ounces meat must be regarded as the equivalent of at least ten ounces vegetables. The British troops during the siege of Kut-al-Amara were doubtless protected from scurvy by their meat or horseflesh rations, but these were very abundant (eight ounces to twenty ounces daily). (See above, p. 146.)

Milk.—Fresh cow's milk was found to possess very low anti-scorbutic value in the case of guinea-pigs. Satisfactory protection from scurvy was only attained on a large ration (see also Fröhlich, 1912). It would seem probable that infants living upon cow's milk do not receive any great excess of vitamine. As regards adults, Curran (1847) instances upwards of eighty cases admitted to the Dublin Union Hospitals in the Irish epidemic of 1847; all had been inmates of the Union for at least six months previously, and the diet, though deficient in vegetables and meat, had included (at least) one pint of milk daily.

We have, nevertheless, been much impressed with the great value of milk, even when heated to 120° C. for one hour to destroy the vitamines, as an adjunct to diet. The general condition of animals who received a minimum amount of anti-scorbutic material could be enormously improved by the addition of a daily ration of this heated milk, although the scurvy was not influenced. Therefore, while admitting that milk is of little importance for the prevention of scurvy (or beriberi), its inclusion in a diet, even when tinned and sterilized, would appear to be a very valuable measure.

Fruit.—Fresh fruit juices appear to be among the most valuable anti-scorbutic materials we possess. In our experimental work fresh orange and lemon juices were found very potent. There is also abundant evidence, dating as far back as the beginning of the seventeenth century,[2] of their value in the prevention of human

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1 Mesopotamia Report, 1917, x, 41.

2 James Lind: "A Treatise on Scurvy," Second Edition, London, 1757.

scurvy. In 1795 a regular issue of lemon-juice[1] was ordered in the Navy, and a remarkable decrease of the death-rate was the result. Sir Gilbert Blane, who appears to be chiefly responsible for this reform, states (1830) that scurvy was banished from the Service within two years from this date. Budd (1840) relates that, whereas 1,457 cases of scurvy were admitted to the Royal Naval Hospital at Haslar in the year 1780, no case was reported in the years 1803-1810.

The juice of limes has also been widely esteemed in the past as an anti-scorbutic. There is not, however, much trustworthy evidence as to the anti-scorbutic value of lime-juice when preserved according to modern methods. We have so far found it disappointing for the prevention or cure of guinea-pig scurvy. Holst and Fröhlich (1912, p. 96), on the other hand, demonstrated distinct anti-scorbutic properties in two commercial samples of lime-juice, purchased in retail shops in Christiania. The subject is one of very great importance, and we are at present engaged on a further investigation, with special reference to the processes of preservation. In the meantime, we are not able to express any definite opinion. One thing, however, seems very clear. There is no reason at all why preserved lime-juice should be regarded as a specially concentrated form of anti-scorbutic. This has seemed to be the view generally held, if one may judge by the small size of the ration issued. If lime-juice is issued at all as an anti-scorbutic, the ration should be a liberal one, at least one ounce daily.

Relation between Beriberi and Scurvy as regards Time of Onset, etc.

It is evident that a diet defective in both classes of vitamine will occasion both beriberi and scurvy, but it is likely that beriberi will precede scurvy in point of time. In "ship beriberi" the symptoms are reminiscent of scurvy, and it is probable that there has been in the diet a deficiency both of anti-beriberi and anti-scurvy vitamines. The "period of resistance" or "period of development" will depend on the degree of deficiency and upon the idiosyncrasy of the individual; but, on the whole, it seems to be shorter in case of beriberi. There is good evidence upon this point in the observations of Fraser and Stanton (1909), who found beriberi developing

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[1] In 1840 the daily ration was 1 ounce lemon-juice and 1½ ounces sugar issued two weeks after leaving land (Budd, 1840).

among Javanese coolies after about eighty to ninety days upon a diet composed largely of polished rice. In case of scurvy, the time seems to be longer. Colonel Hehir[1] considers four months to be the minimum time in which scurvy will appear in Indian troops on active service, and Holst and Fröhlich (1912) refer to two instances in which the time was longer. The first is that of a fanatical vegetarian who wished to prove to the world that human life could be sustained upon a diet of bread and water. The bread was presumably rye bread, and the individual therefore well supplied with anti-beriberi vitamine; he developed scurvy in seven and a half months. The second was related by a political refugee in Norway, and deals with the case of 1,400 prisoners in a Russian convict prison. The diet consisted of tea, coarse bread and cabbage soup; the preparation of the latter was so unclean and disgusting that twenty of the prisoners, who were of gentler birth than the others, could not endure to take it. After about six months these twenty showed symptoms of scurvy, while no case occurred among the rest of the prisoners who took the soup. This incident also shows that even after a prolonged boiling enough anti-scorbutic vitamine remained undestroyed in the cabbage leaves to protect from scurvy.

It is not improbable that the times of onset of these two deficiency diseases might be much shortened in case of any intestinal infection occurring during the "period of development." Such a disease might well impose a drain upon the metabolism, which would involve the reserve of vitamines as well as the other resources. It is interesting in this connexion to note that among twenty-six cases of beriberi diagnosed in our troops in the Dardanelles in the autumn of 1915, and noted by Willcox (1916), eighteen had suffered from diseases of the digestive and alimentary system previous to the beriberi. At the same time it is possible that the first illness may only indirectly have predisposed to the beriberi by making it necessary to further restrict the already limited diet to such vitamine-free articles as tinned and sterilized milk, etc.

The following case (for details of which I am indebted to Dr. Frank Savery, of Ealing) of a little girl, aged 2, who acquired scurvy while suffering from chronic colitis, is also to the point. Cow's milk could not be taken, and the child was nourished on a brand of dried milk with the addition of raw meat-juice to her diet as an anti-scorbutic. After some months on this diet scurvy was

[1] Mesopotamia Report, 1917, x, 41.

diagnosed, but was readily cured by fresh orange-juice. Fresh meat-juice has been considered by many clinicians an adequate anti-scorbutic for infants upon a diet of sterilized milk, and is also much esteemed as a cure for infantile scurvy. This incident suggests that the colitis rendered the child more susceptible to scurvy than a normal infant, and also points to the great anti-scorbutic potency of fresh orange-juice in comparison with meat-juice.

Summary.

(1) To maintain a human being in a satisfactory state of nutrition the diet must contain: (*a*) A suitably proportioned supply of protein, fat, carbohydrate, salts and water, and (*b*) an adequate amount of accessory food factors, or vitamines. Both (*a*) and (*b*) are required; excess of one cannot make good any deficiency in the other.

(2) These necessary vitamines are (at least) of two kinds; firstly, the anti-neuritic or anti-beriberi vitamine, deficiency of which in a diet occasions beriberi, and secondly, the anti-scorbutic vitamine, deficiency of which occasions scurvy.

(3) Neither of these vitamines has yet been isolated in a pure state, and, for the moment, their presence can only be detected by biological methods.

(4) These two classes of vitamines have each their individual rôle in metabolism; they possess properties different from each other and are differently distributed among natural foodstuffs.

(5) The distribution of the anti-beriberi vitamine has been investigated by study of experimental polyneuritis in birds, which is generally accepted as analogous to human beriberi. Pigeons, if deprived of anti-beriberi vitamine (e.g., on an exclusive diet of polished rice or white wheat flour, etc.) develop acute polyneuritis (beriberi) in fifteen to twenty-five days. The presence and relative amount of the anti-neuritic vitamine contained in various foodstuffs has been determined by means of curative experiments, and by preventive trials with specially selected diets. In this work we have extended the observations of Cooper (1913-1914) and have, in general, followed his methods.

(6) The anti-beriberi or anti-neuritic vitamine was found in almost every natural foodstuff examined. The principal source is in the seeds of plants, e.g., cereals and pulses. The most important result emerging from the present work is the fact that *in cereals the anti-beriberi vitamine is mainly deposited in the germ or embryo*

of the grain, and to a less extent in the bran. White wheaten flour or polished rice, which consist of the *endosperm* (minus *aleurone layer*) of the grain, is deficient in this vitamine, and, if employed as a sole diet, will occasion polyneuritis in pigeons or beriberi in man.

Other important sources of anti-neuritic vitamine are the eggs of animals (e.g., hens' eggs or fish roe) and yeast, or yeast extract. Milk and cheese gave disappointing results (Cooper, 1914).

(7) From the abundant presence of the anti-beriberi vitamine in dry foodstuffs it is clear that this substance is resistant to drying. It can also withstand exposure to temperatures in the neighbourhood of 100° C. for two hours without significant loss; if heated under pressure to or near 120° C. destruction takes place more rapidly (see Table V).

(8) The distribution of the anti-scorbutic vitamine has been investigated by a study of experimental scurvy in guinea-pigs. We have followed the methods of Holst and his co-workers (1912) with some modifications. A diet of cereals with water or sterilized milk will cause death from acute scurvy in these animals within a month. The influence of various foodstuffs in preventing scurvy, when added to this "scurvy diet," has indicated where the principal sources of the anti-scorbutic vitamine are to be found.

(9) The anti-scorbutic vitamine is present in active, living vegetable tissues. It is also present in animal tissues to a much less degree. Fresh vegetables and fresh fruit juices are the most valuable sources of anti-scorbutic vitamine that we possess. All the dry foodstuffs examined, including desiccated vegetables, were more or less deficient in this vitamine.

(10) Dry pulses (or cereals), though rich in anti-beriberi vitamine, are deficient in anti-scorbutic vitamine and afford no protection against scurvy. If these are moistened, however, and allowed to germinate, the anti-scorbutic principle is regenerated with the beginnings of active cell life.

Germinated pulses are recommended as a valuable and convenient means of preventing scurvy in the absence of fresh fruit and vegetables. In the dry stage they are eminently suitable for transport, and can be moistened and germinated on the spot as required. In the Appendix is given a method for preparing germinated lentils or peas under active service conditions.

(11) It is evident from (9) and (10) that the anti-scorbutic vitamine is extremely sensitive to drying. As regards exposure to high temperatures it is also more unstable than the anti-beriberi vitamine.

Holst (1912) found that the anti-scorbutic power of fresh cabbage was slightly lessened after exposure to 100° C. for half an hour, but that the deterioration was appreciable after one hour; at 110°-120° C. the destruction was rapid and complete.

(12) It follows from (7) and (11) that neither the anti-neuritic vitamine nor the anti-scorbutic vitamine may be expected to survive in tinned or sterilized foods, considering the high temperature to which these have been subjected in course of preparation.

(13) In case of armies or other populations subsisting largely on tinned foods, it is imperative to provide an adequate supply of vitamine from outside sources.

To prevent beriberi the bread or biscuit should be made from wholemeal or germ-containing flour.

To prevent scurvy, if a supply of fresh fruit or vegetables is not procurable, germinated pulses should be added to the diet.

In conclusion, our best thanks are due to the following firms for generous help in the supply of material for our investigations: To Messrs. Steele and Co., rice millers, to Messrs. Brown and Polson, maize millers; to the Hovis-Bread Flour Co. and to Messrs. J. and H. Robinson, wheat millers, and especially to Mr. E. G. Ellis, of the last named firm for much kind help, information and advice; to Messrs. L. Rose and Co. for samples of specially prepared lime-juice; to Elizabeth Lazenby and Son, to Harrod's Stores, and to Messrs. Crosse and Blackwell. We also wish to express our thanks to Professor Harden, F.R.S., for kindly preparing some of the extracts mentioned in Table II; to Miss Mabel Rhodes for making the drawings from which figures 1 to 6 are made; and lastly to our assistant, Mr. A. H. Robins, for his devoted care and feeding of the experimental birds in the beriberi inquiry.

APPENDIX.

Method of using Peas, Lentils, or other Pulses (Dhall) for the Prevention of Scurvy, in the absence of Fresh Vegetables.

(1) The dry seeds must be whole, retaining the original seed-coat, not milled or decorticated (see fig. 5 (*a*) peas, and (*b*) lentils).

(2) They must be soaked in water for several hours; the time necessary depends on the temperature, twenty-four hours at 50° F. to 60° F. and twelve hours or less at 90° F.

(3) The water must then be drained away, and the peas, etc., allowed to remain in the moist condition with access of air. They will then germinate and the small rootlet grow out as in fig. 6: (*a*) peas, and (*b*) lentils. This germination will take forty-eight hours at 50° F. to 60° F., and twelve to twenty-four hours at 90° F.

(4) The operations described in (2) and (3) could conveniently be done under active service conditions in such manner as the following:—

Soaking.—The peas or other pulses, placed in a *clean* sack, should be steeped in a trough, barrel, or other suitable vessel, full of clean water, and should be occasionally stirred. The sack and trough, etc., should be large enough to allow for the swelling of the peas to about three times their original size. In a hot climate six to twelve hours should suffice for this soaking.

Germination.—The peas should be lifted out of the water and spread out to a depth *not exceeding two to three inches* in a trough or other vessel with sides and bottom porous or well perforated with holes. This is to allow *complete* access of air. *The seeds must be kept in a moist atmosphere.* This is done by covering with damp cloth or sacking, which is sprinkled (by hand or automatically) as often as is required to keep the peas thoroughly moist underneath. The germination should reach the stage shown in fig. 6 within twenty-four hours in a hot climate.

All the vessels should be clean.

(5) *It is important that the germinated pulses should be cooked and eaten as soon as possible after germination, and should not be allowed to become dry again;* in that case the anti-scorbutic properties, acquired during the process of germination, will again be destroyed. The pulses should not be cooked longer than necessary.

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THE PHYSIOLOGICAL BASIS OF ELECTRICAL TESTS IN PERIPHERAL NERVE INJURY.

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The method of testing by means of the electrical reactions in cases of peripheral nerve injury has been in use for twenty years and more. From time to time the apparatus of the test has been modified and stress had been laid now on one and now on another of the phenomena which go to make up the classic reaction of degeneration. The importance of the polar reversal has yielded place to that of rapidity of contraction, condensers have replaced the faradic and galvanic current, and yet it is scarcely an exaggeration to say that as far as any relevant diagnosis or prognosis is concerned no advance has been made since Erb's work first appeared. The position has been stated clearly and pitilessly by Dr. Burke in a recent number of the *Archives of Radiology and Electro-Therapeutics*, and his analysis makes it easy to understand how it has come about that neurologists are more and more inclined to rely on changes in sensation, tone, nutrition of muscles, etc., and having made their prognosis on these grounds to leave the electrical reaction to those who are interested in them.

However, although the practical results of electrical testing are still very much where they were twenty years ago, it is a mistake to suppose that the theoretical side of the subject has been equally stationary. During the past fifteen years physiologists have been investigating the conditions necessary for the electrical stimulation of isolated muscle and nerve, and since the war their results have been applied to the study of the electrical reactions in man. The outcome of this is that we are now in a position to state exactly what we can hope to find out from these reactions and to consider the best method of testing them. To anticipate, it may be said that as far as prognosis is concerned there is little to be gained by the use of elaborate methods and technique, and that the only practical points we can decide are (*a*) whether the nerve is or is not

in functional continuity with the muscle, and (*b*) whether the muscle will be still capable of contracting when the nerve has regenerated.

The recent advances in our knowledge of the mechanism of electric stimulation in isolated muscle and nerve preparations are due almost entirely to the work of Keith Lucas in England and of Lapicque and his pupils in France. A résumé of this work in so far as it touches on the subject of electrical testing has been published by Laugier[1] and more recently by Tinel[2] and by the present writer;[3] for this reason it will be considered as briefly as possible. The important facts are as follows: If we take a simple excitable structure such as an isolated nerve fibre or striated muscle fibre and use as stimulus the simplest and most easily adjusted form of current, namely, a galvanic current of known strength and known duration, we find that there are two limiting factors which determine the success or failure of the stimulus. These are: (1) A certain minimal strength and (2) a certain minimal duration. However strong it may be, the current will not excite if its duration is shorter than a certain time, and its strength cannot be reduced below a certain level, however the duration may be prolonged. Within these limits the necessary strength and duration are related in the following way. For all durations which are long compared with the minimal duration, the strength of current required to excite remains constant at its minimal value. As the minimal duration is approached the strength must be increased, and the increase becomes more and more rapid as the duration is reduced. Fig. 1 shows this relation graphically, ordinates giving current strength and abscissæ the corresponding duration. This form of curve has been found for every excitable tissue hitherto investigated. Various equations have been proposed to describe the curve, but for practical purposes it may be defined by two factors which Lapicque has called the rheobase and the chronaxie. The rheobase is equal to the strength of current required to excite when the duration is infinite (Rh. in fig. 1), and we may consider it as depending on the absolute excitability of the tissue in question. The chronaxie depends on the rapidity of the excitation process,

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[1] *Biol. Med.*, p. 89, 1914.

[2] "Les Blessures des Nerfs," Masson et Cie, 1916, p. 50.

[3] *Brain*, xxxix, p. 1, 1916.

and it is equal to the duration at which the current must be increased to twice its minimal strength, i.e., to twice Rh. in fig. 1. The rheobase is of little practical importance as an index of the condition of the tissue, for it is impossible to compare it in different cases with any profit unless the conditions of stimulation are very accurately controlled as to resistance, current flow per unit area, etc. On the other hand, the chronaxie can be measured without any of these precautions, since we need only determine the duration at which the current strength must be twice the

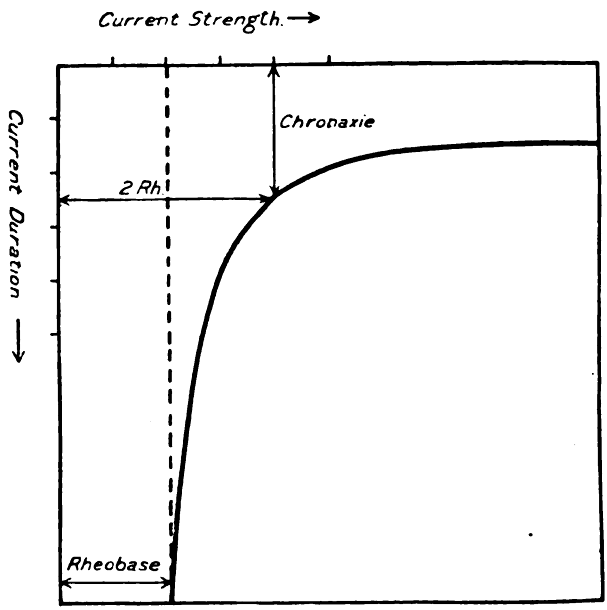

FIG. 1.—Relation between least strength and least duration of current necessary for successful excitation.

threshold value, and the disposition of electrodes, resistances, etc., does not matter. It is found to be remarkably constant for similar tissues examined under similar conditions of temperature, perfusing fluid, etc. Further, it shows very great variations in different types of tissue. For instance, in the medullated nerve of the frog its value is always in the neighbourhood of 0·0005 second at 15° C. In the frog's striated muscle it is 0·007 second.

It appears, then, that in the chronaxie we have a constant which is definitely related to the state of the excitatory mechanism of the tissue, and this has been abundantly confirmed both from the empirical and the theoretical standpoints. Its value allows us to predict the reaction of the tissue to currents of any form and duration, and gives us some idea of the time relations of most of the phenomena taking place in the tissue, e.g., the rate of conduction, the rate of recovery, etc., in addition to the rate of excitation. In fact, if it is necessary to single out any one constant which will suffice to indicate the condition of an excitable tissue, the chronaxie is by far the most valuable constant to select.

It is naturally an easier matter to determine the chronaxie alone instead of the whole curve, relating current strength to current duration, and therefore we shall deal first with the results obtained from measurements of the chronaxie in human muscles under different conditions of nerve injury.

The Chronaxie of Human Muscles.

These measurements have been carried out by Lapicque,[1] Laugier,[2] Bourguignon[3] and others. They find that when the nerve is intact the chronaxie measured with the cathode applied to the motor point of the muscle or to the nerve supplying it has a value varying from 0·00015 to 0·0006 second, according to the muscle in question. Working independently of them I have obtained results which are in very close agreement with theirs, namely, 0·00012 to 0·0008 second for muscle with intact nerve supply. In muscles whose nerve supply is completely destroyed, the chronaxie is very much longer and is usually of the order of 0·01 second. Here, too, the results of different observers agree very well together. Typical values for muscle with intact and with degenerated nerve supply may be seen in Table I. These figures are taken at random from various cases of peripheral nerve injury or disease at different periods from the onset of the condition. It will be seen that in every case the chronaxie for muscle with degenerated nerve supply is at least fifteen times as long as the value with intact nerve, and that it may be 200 times as long.

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[1] *Comptes Rendus*, clxi, p. 643, 1915.
[2] Loc. cit. [3] *Comptes Rendus*, clxiii, p. 68, 1916.

TABLE I.

Case	Duration since onset	Chronaxie: Affected side	Chronaxie: Intact side
Divided sciatic (tibialis anticus).. ..	9 months ..	0·011 sec. ..	0·00012 sec.
,, ,, ,, ,, ...	1½ ,, ..	0·013 ,, ..	0·00025 ,,
,, extl. popliteal (tibialis anticus)	5 ,, ..	0·013 ,, ..	0·00016 ,,
Poliomyelitis (tibialis anticus)	2 ,, ..	0·016 ,, ..	0·00016 ,,
,, ,, ,, ...	1½ ,, ..	0·013 ,, ..	0·0005 ,,
Neuritis (deltoid)	4 ,, ..	0·008 ,, ..	0·00016 ,,
Polyneuritis (tibialis anticus)	3 ,, ..	0·022 ,, ..	0·0004 ,,
Bell's palsy (orbicularis palp.)	4 ,, ..	0·010 ,, ..	0·00024 ,,
,, ,, ,, ,, ...	1½ ,, ..	0·030 ,, ..	0·0005 ,,

Whatever interpretation may be put upon these results it is easy to trace their connexion with the classical methods of investigation with faradic and galvanic currents. The faradic coil gives a series of induced currents of very short duration frequently repeated. The effective duration of each shock varies with the dimensions of the coil, but it is of the order of 0·001 second. The galvanic current is a current of long duration. Its exact length is uncertain when the circuit is made and broken by hand, but it is probably never much shorter than half a second. Now in human muscles with intact nerve supply the chronaxie is about 0·0002 second; that is, the duration of the current may be reduced to 0·0002 second, and it will be still capable of exciting the tissue if its strength is twice the threshold value. Consequently, the brief current from an induction coil lasts quite long enough to excite. On the other hand, when the nerve has degenerated the current strength must be doubled at a duration of 0·01 second, and at shorter durations it must be increased still further. As will be seen from the actual curves[1] the increase tends to infinity at about 0·002 second, and a current of shorter duration than this will not excite, however strong it may be. This change in the time constants will not alter the effect of the long galvanic current, but it will evidently prevent the shorter faradic current from exciting. Thus the muscle reacts to galvanism but not to faradism.

This explanation of the failure of faradic currents owing to the short duration of the discharge has been recognized for many years, and the present results only help to emphasize the import-

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[1] Figs. 2 and 3, p. 166.

ance of the current duration in determining the success or failure of the stimulus; they give no indication as to the reason for the slowing of the time factor when the nerve degenerates. To decide this question, which lies at the root of the whole subject of electrical testing, we have to consider the complete curve, relating current strength and current duration instead of contenting ourselves with the measurement of the chronaxie alone.

Before dealing with these curves it will be as well to indicate briefly the technical details involved in their measurement and in that of the chronaxie.

Method of Investigation.

The apparatus consists essentially in a potentiometer arrangement for varying the potential difference between the electrodes from 10 to 100 volts, and a mechanical contact breaker capable of delivering currents varying in duration from 0·0001 second to 0·05 second. The pendulum or spring contact breakers devised by Keith Lucas[1] for physiological work are admirably suited to this, and I have always employed the Lucas pendulum.[2] Lapicque uses a rotating arm contact breaker driven by a falling weight. Bourguignon has been able to measure the chronaxie by the use of condenser discharges, but the method is too complicated to allow of the determination of more than a few points on the curve.

As regards the electrodes the simplest method consists in using as cathode a small pad closely applied to the skin by a bandage, and as anode a large pad also fixed firmly in some indifferent region. This is quite satisfactory in practice, for the strength of current needed to excite at a standard duration does not change by more than 5 per cent during a series of measurements lasting half an hour or more. In some cases where there is a liability to error from current spread to neighbouring muscles, it is better to use as cathode a small platinum needle thrust into the substance of the muscle. This allows a much more exact localization of the stimulus, and the movement of the needle gives a clear indication of contractions too weak to cause any obvious deformation of the skin surface.

In constructing a curve the first step consists in determining the least strength of current needed to give a contraction when the duration is several seconds. This is spoken of as the strength of infinite duration, since any further increase in duration is not likely to affect the result. To determine the chronaxie the current strength is doubled and its

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[1] "Catalogue of Physiological Instruments," Cambridge Scientific Instrument Co., 1914.

[2] *Journ. of Physiol.*, 1903, xxxvii, p. 460.

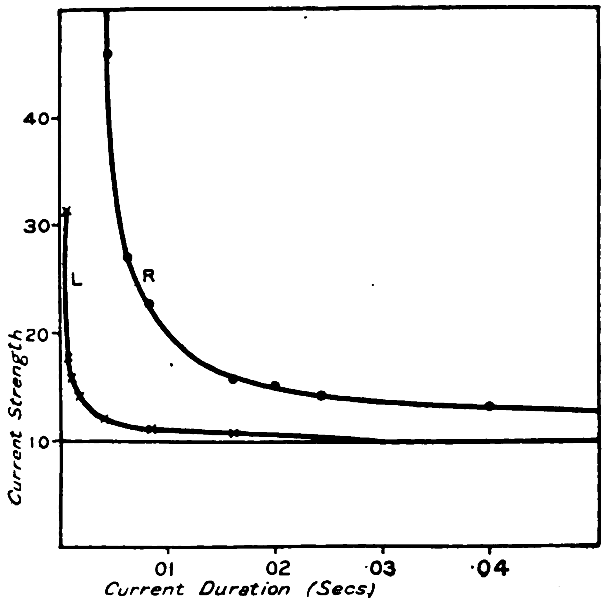
40
30
20
10
L
R
Current Strength
01
02
·03
·04
Current Duration (Secs)

FIG. 2.

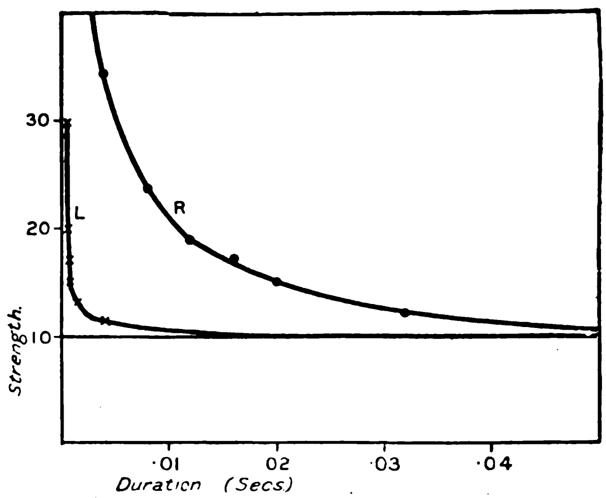
30
20
10
L
R
Strength.
·01
02
·03
·04
Duration (Secs.)

FIG. 3.

duration is reduced until the muscle just ceases to contract in response to it. The chronaxie is the shortest duration at which a contraction is obtained with this strength. The rest of the curve can be mapped out either by varying the current strength and finding the least effective duration corresponding to each strength, or else by varying the duration and finding the least effective strength. From time to time the strength at infinite duration is redetermined to make certain that the excitability of the tissue has not altered during the experiment.

In expressing results the strength at infinite duration is given the value IO, and other strengths are expressed as multiples of this. There is no need to measure the absolute strength of the current since we are concerned only with the relation between the strengths needed at different durations.

The Strength-Duration Curve of Human Muscles.

Figs. 2 and 3 may be taken as typical curves for human muscle with intact and with degenerated nerve supply. Fig. 2 shows the strength-duration curve of the tibialis anticus in a patient whose right sciatic nerve had been shot through six months previously. The curve marked L is that for the left leg where the nerve supply is intact, and that marked R is for the right leg where the nerve has degenerated. In fig. 3 the curves are those of the right and left orbicularis palpebrarum in a case of right-sided facial paralysis two months from the onset, and showing no signs of recovery. These figures show the great change in the time factor when the nerve degenerates, the chronaxie falling from 0·0003 to 0·012 second in the sciatic case and from 0·00024 to 0·010 second in the facial palsy.

We have now to decide what happens to the *rapid* curve when the nerve begins to degenerate; how it becomes transformed into the *slow* curve, and how this regains the normal time relations when the nerve regenerates again. Figs. 4, 5 and 6 are typical examples of the curves determined in cases where the nerve is in process of degeneration or regeneration. Fig. 4 is from a case of facial paralysis twelve days after the onset, and figs. 5 and 6 are from cases of acute anterior poliomyelitis with incomplete paralysis of the tibialis anticus.

It will be seen that all these curves are complex; they are made up of a steep, sharply bent curve when the current strength is high and the duration short and a slower and more gradual curve when the duration is longer and the strength less. The time

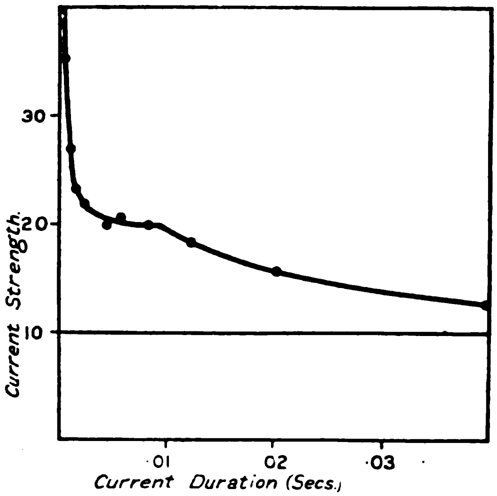
30
20
10
Current Strength.
·01
02
·03
Current Duration (Secs.)

Fig. 4.

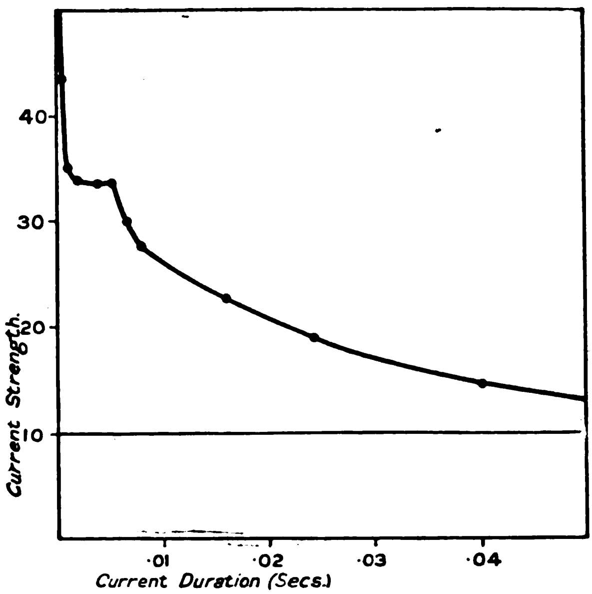
40
30
20
10
Current Strength.
·01
·02
·03
·04
Current Duration (Secs.)

Fig. 5.

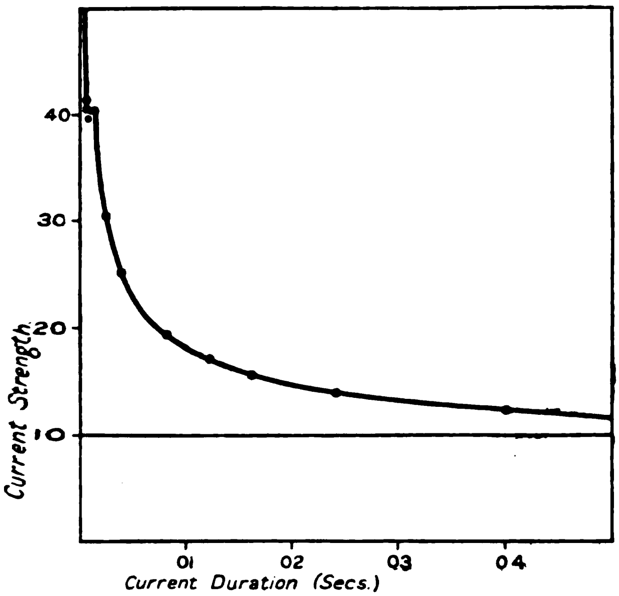

FIG. 6.

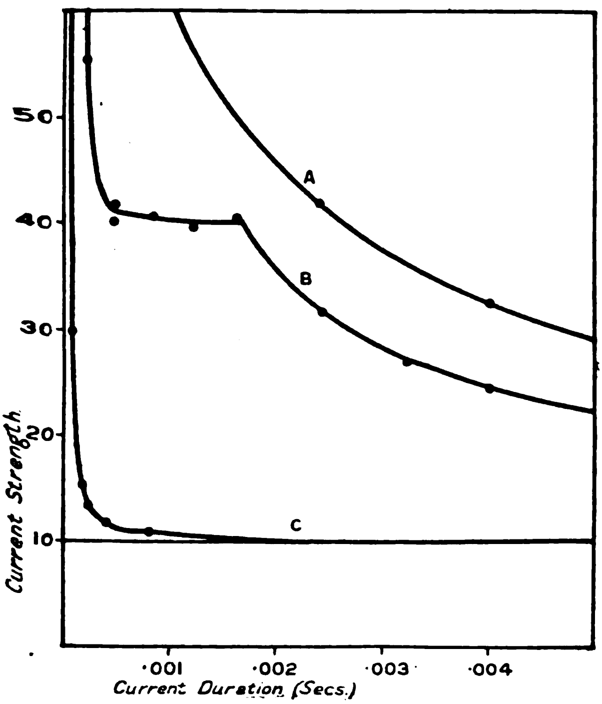

FIG. 7.—A. Tibialis anticus after division of sciatic; B. Tibialis anticus after poliomyelitis; C. Tibialis anticus with intact nerve supply.

constants of these two components of the curve are found to agree very closely with the average values for muscle with intact and with degenerated nerve supply. For instance in fig. 4 the lower part of the curve has a chronaxie of 0·008 second, and the upper part, if we consider it to arise from the rheobase marked B in the figure, has a chronaxie of 0·0003 second. This is shown more clearly in fig. 7, which gives the curve in fig. 6 on a more extended time scale and also typical curves for normal and for denervated muscle. It is evident that the complex curve in fig. 7 is made up of two curves having the time constants of normal and of denervated muscle respectively. These complex curves are found in every case which does not give either the simple curve with the short chronaxie typical of intact muscle (0·0005 second or less), or else the simple curve with the long chronaxie of denervated muscle (0·008 second or more). At no stage of degeneration or regeneration has a simple curve been found with a chronaxie of some intermediate value—say 0·003 second. We must conclude, therefore, that there is no gradual transition from the rapid to the slow curve as the nerve degenerates. Instead of this we have a period in which both curves are found together and the transition consists in one curve becoming more and more prominent to the ultimate exclusion of the other.

This transition may be seen very clearly in fig. 8, which gives the whole history of a case of facial paralysis from onset to fairly complete recovery. During the first eight days after the loss of voluntary power the curve remains absolutely unchanged. On the twelfth day a double curve is obtained, the discontinuity occurring when the current strength is 20. On the fifteenth day the rapid curve has been almost entirely replaced by the slow, but it is still possible to detect a break in the curve at a current strength of 55, and with greater strengths than this the curve is of the rapid type. On the sixteenth day no discontinuity can be found and the curve is of the slow type throughout. The chronaxie of the slow curve becomes gradually longer and longer until the thirty-third day, when the rapid curve reappears at a current strength of 52. The first suggestions of returning voluntary power had appeared a day or two before, but it was not possible to say for certain that any power had returned until the thirty-fifth day. After the thirty-third day the rapid part of the curve appears at weaker and weaker current strengths and eventually it completely replaces the slow curve about sixty days after the onset of the paralysis.

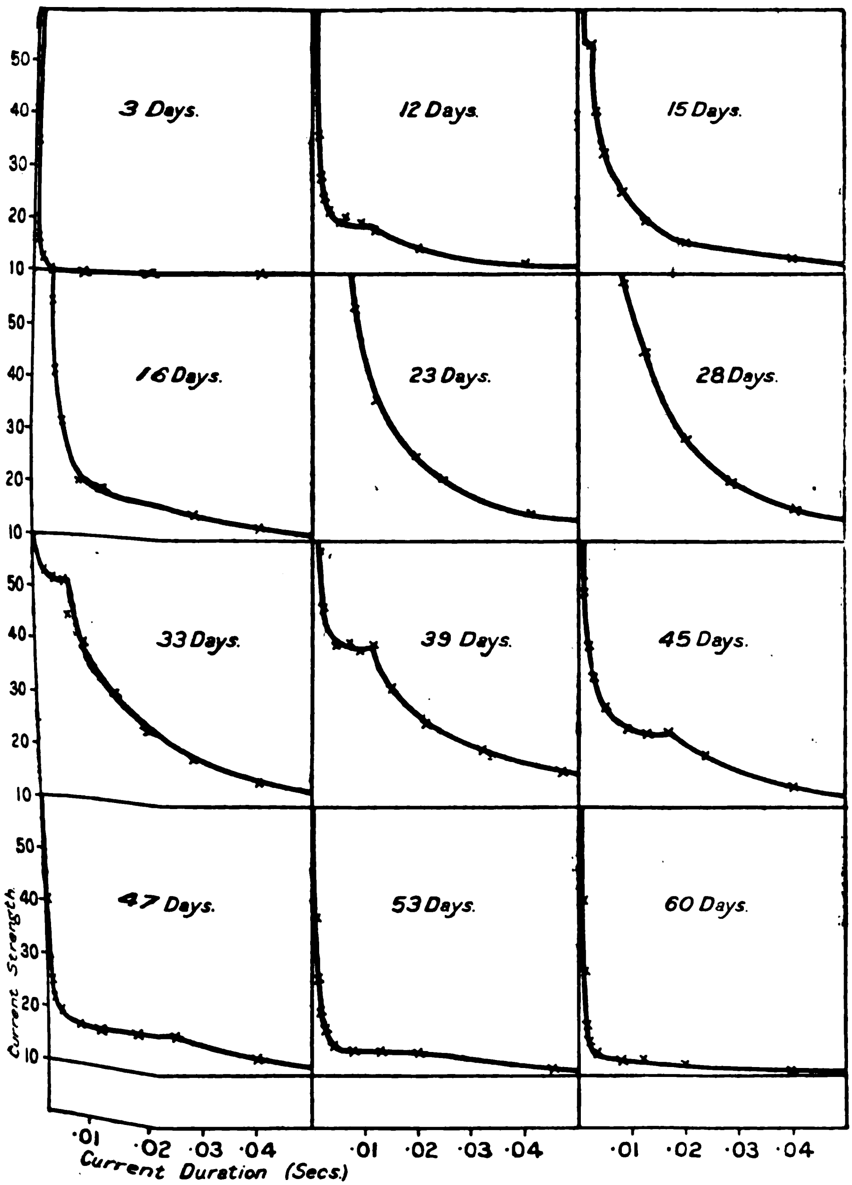
3 Days.
12 Days.
15 Days.
16 Days.
23 Days.
28 Days.
33 Days.
39 Days.
45 Days.
47 Days.
53 Days.
60 Days.
Current Strength
Current Duration (Secs.)
10
20
30
40
50
·01
·02
·03
·04

Fig. 8.

The different values of the chronaxie are set out in Table II in two columns corresponding to the rapid and the slow curve. It will be seen that the chronaxie of the rapid curve alters very little, whereas that of the slow curve becomes gradually longer and longer until the moment when the rapid curve begins to appear again.

TABLE II.—FACIAL PARALYSIS, PERIPHERAL TYPE.

	Reactions of Right Orbicularis Palpebrarum — Chronaxie	
Days after onset	Rapid curve	Slow curve
3	0·0005 sec.	—
5	0·0005 ,,	—
8	0·0004 ,,	—
12	0·0003 ,,	0·008 sec.
15	0·0004 ,, (?)	0·012 ,,
16	—	0·014 ,,
23	—	0·030 ,,
28	—	0·032 ,,
33	0·0075 sec. (?)	0·028 ,,
37	0·0075 ,,	0·032 ,,
39	0·0005 ,,	0·033 ,,
41	0·0005 ,,	0·032 ,,
45	0·0004 ,,	0·025 ,,
47	0·0003 ,,	0·017 ,,
53	0·0003 ,,	0·011 ,, (?)
60	0·0004 ,,	—

The explanation of these curves is simple enough. Evidently we have to deal with two distinct excitable mechanisms, one with a short time factor and one with a long. When the nerve is intact the current which is just strong enough to cause a contraction takes effect on the rapid mechanism alone. It is quite possible that strong currents may excite the slow mechanism as well, but the effect of this would be masked by the greater excitability of the rapid mechanism. As the nerve degenerates, the rapid mechanism needs stronger and stronger currents to excite it, and at weak strengths and long durations the slow mechanism comes into play. Eventually the rapid mechanism becomes completely inexcitable and the current takes effect on the slow mechanism alone. When the nerve regenerates, the rapid mechanism appears again. At first it requires very strong currents to excite it at all, but as time goes on it becomes more and more excitable and finally it replaces the slower mechanism completely.

Since the rapid curve disappears when the nerve degenerates

and reappears when it regenerates, we have a prima facie case for assuming that the rapid mechanism may be identified with the nerve fibre and the slow mechanism with the muscle fibre. When the nerve supply is intact the current takes effect on the nerve and short durations are effective on account of the short time constants of the nerve. When the nerve has degenerated the current can only take effect on the muscle fibre directly and longer durations are necessary. This amounts simply to the time-honoured theory that the faradic current acts on the nerve and the galvanic on the muscle, and before it can be accepted we must consider the objections which have stood in the way of general approval of this theory. It must be admitted that these objections are not very grave and that the theory has failed to win acceptance rather from lack of definite proof than from any other reason.

In the first place we know that nerve tissue has in general a very much shorter chronaxie than muscle tissue. This has been proved for many different types of muscle and nerve by Keith Lucas and Lapicque. For instance the muscle fibre of the frog's sartorius gives a chronaxie of 0·007 second, and the nerve fibres supplying the muscle give one of 0·0005 second. By selecting a region of the muscle where the intramuscular nerve fibres are relatively inexcitable, it is possible to obtain double curves of the type shown in figs. 4, 5 and 6, the rapid curve with strong currents being due to excitation of the nerve fibres and the slower curve to the muscle fibres.[1] The rapid curve disappears when the nerve endings are paralysed with curare and reappears when the effect of the curare has subsided. In this case there can be no doubt that the mechanisms in question are the nerve fibre and the muscle fibre. Moreover the effect of curare shows that if the frog's nerve were damaged we should find the strength-duration curve passing through exactly the same series of changes as those observed in human muscle when the nerve degenerates. It is only reasonable to conclude that we have to deal with the same mechanisms in the case of human and of amphibian tissues.

In the case of the rapid curve we have a further proof that it represents the excitation of the nerve fibre from the fact that the same curve is obtained whether we use a cathode placed over the

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[1] Lucas, *Journ. Physiol.*, 1907, xxxvi, p. 113.

muscle itself or over the nerve trunk supplying it.[1] The only excitable structures in the nerve trunk are the nerve fibres, and therefore we may be certain that the rapid curve shows the conditions necessary for the stimulation of these nerve fibres, whether they are collected together in the nerve trunk or scattered through the substance of the muscle.

The slow curve has been assigned to the muscle fibre excited directly without the intervention of the nerve fibre. Against this view there is one objection which must be considered in detail. This is based on the experimental observation that a curarized muscle can be excited successfully by a faradic current. We have supposed that the muscle with degenerated nerve supply responds only to galvanism because the faradic current is too rapid to excite the muscle fibres. How then does it come about that the faradic current is able to excite the muscle fibres after the nerve supply has been cut off by curare? In the first place it might be pointed out that the two cases are not strictly comparable because a strong current is effective at much shorter durations than a weak, and it is possible to use a much stronger current in the case of an isolated preparation than in the case of an unexposed muscle stimulated through the skin. There is indeed some evidence that a faradic current, if it is sufficiently strong, may be able to produce a contraction in denervated mammalian muscles.[2] Again, the discharges from two coils of different patterns may have very different time constants and there may be coils in use which give a discharge long enough to stimulate muscle tissue when the self-induction is increased by sliding in the core. However, the objection may be answered without appeal to this evidence from a consideration of the curves in fig. 8. In this case the slow curve which we have assigned to the muscle fibre has a chronaxie of 0·008 second when it first appears twelve days after the onset of

[1] Occasionally the chronaxie of the muscle at its motor point is actually shorter than that of the nerve trunk. The differences are small and not easily measured. If they are not due to experimental error, they are probably brought about by stimulation of the nerve-ending substance in the muscle by very rapid currents. The curve due to this substance can be detected in amphibian preparations, and it is more rapid than that of either nerve fibre or muscle fibre. However I have not yet been able to obtain a triple curve in mammalian muscle corresponding to nerve-ending nerve and muscle.

[2] Langley, *Lancet*, July 1, 1916. Cumberbatch ?

the paralysis. The chronaxie becomes gradually longer and longer until the twenty-eighth day, when it has reached the value of 0·032 second. After this the rapid curve reappears and the chronaxie of the slow curve becomes stationary and then begins to diminish again as recovery progresses. Now it is clear that the value of 0·032 second is not the chronaxie of the healthy muscle fibres, but of muscle fibres which have suffered by deprivation of their nerve supply. Even the original value of 0·008 second may be considerably longer than that of the muscle fibre before the nerve was damaged, though it is probably not much longer, since the nerve fibres are still excitable on the twelfth day and it is unlikely that the muscle can have undergone much change at this date. It is clear then that we must reckon with the possibility of a slow progressive lengthening of the chronaxie for muscle after the nerve supply is cut off, and for this reason we cannot expect to find that a muscle with degenerated nerve supply will respond to the shortest currents which are capable of exciting a healthy muscle an hour or so after the nerve supply has been cut off by curare.

This appears to dispose of the only serious objection to the theory that the nerve fibre and the muscle fibre are the two mechanisms responsible for the rapid and the slow curve. Various alternative theories have been considered in a previous paper[1] and for the present it must suffice to say that they have little experimental basis and that they do not take into account the evidence given by amphibian muscle and nerve preparations.

Discussion of Results.

It remains to consider the bearing of these results on the practical question of diagnosis and prognosis. In the first place, if the muscle responds to currents of short duration, 0·001 second or less, we may be certain that there are some excitable nerve fibres in functional connexion with the muscle. As may be seen from fig. 8, these fibres will become less excitable if the nerve is degenerating and more excitable if it is regenerating. These changes can be made out easily enough from the strength-duration curve and they might be inferred less certainly by the use of condenser discharges or even by the induction coil. Once the

[1] Adrian, *Brain*, loc. cit.

nerve fibres peripheral to the lesion have become completely inexcitable, we can only hope to determine the condition of the muscle, and electrical methods cease to give any indication of the condition of the nerve at the seat of injury. For this reason electrical testing must play an extremely subordinate part in deciding such questions as whether the cut end of a nerve is growing down towards the muscle or is blocked by scar tissue, whether an operation is advisable, etc. As Tinel points out,[1] there are several important and definite signs of regeneration which appear long before there is any change in the electrical reactions, and when the change does occur it can only confirm what was already known.

However, something may be gained from a knowledge of the chronaxie of the muscle after the nerve has degenerated. If it increases steadily, as in fig. 8, it is clear that the muscle is deteriorating, and if regeneration is delayed there is a possibility that the muscle will be disorganized before the nerve succeeds in reaching it. In many cases the chronaxie remains stationary at a value of about 0·01 second for long periods. This is particularly noticeable in peripheral nerve injuries due to gunshot wounds. For instance, in five cases of complete division of the sciatic the chronaxie of the tibialis anticus was never greater than 0·013 second even at an interval of nine months after the wound. The chronaxie reaches much longer values in the case of muscles which are prone to waste rapidly, e.g., the small muscles of the hand in median and ulnar injuries, but on the whole the increase seems more liable to occur when the nerve injury is due to some toxic condition, as in poliomyelitis, polyneuritis, etc., and not to simple trauma. The most rapid increase I have found was that occurring in the case of facial paralysis recorded in fig. 8.

This increase in the chronaxie of the muscle may give some grounds for a gloomy prognosis and it might even be used as an argument in favour of operation if there was any reason to suppose that an operation would hasten the regeneration of the nerve; however, its most useful application would be in determining the value of the different forms of treatment which are used to maintain the muscle in as healthy a condition as possible pending regeneration of the nerve. For example, it is generally held that

[1] Loc. cit., p. 76.

daily treatment with the galvanic current or some other form of electricity is essential to the well-being of the paralysed muscle; and yet the most recent and the most accurately controlled observations[1] suggest that such treatment has little or no effect at all. If it could be shown that electrical or any other form of treatment would diminish or abolish the slow progressive increase in the chronaxie of the muscle, we should have a strong argument in favour of the treatment under investigation. For the present we must be content to point out the possibility of research on these lines. As yet no results are available for analysis.

In conclusion it may be as well to consider the statement made in the introduction of this paper to the effect that for prognosis or diagnosis little was to be gained by the use of elaborate methods. It has been shown that as long as the nerve fibres in the substance of the muscle are excitable at all we shall be able to produce a contraction by currents of very short duration. When these fibres are inexcitable, the current can only take effect on the muscle and long durations are necessary. The presence or absence of excitable nerve fibres can be detected well enough by the ordinary faradic coil, and except for purposes of research there is little to be gained by the use of condensers or any other more elaborate method. By these methods we might be able to detect changes in the relative excitability of the muscle and the nerve fibres, but it is doubtful if this can be done with any degree of certainty without determining the complete strength-duration curve. When the nerve has degenerated the faradic current becomes ineffective, since it is too rapid to excite the muscle fibres. As soon as this state of affairs is reached electrical methods cease to give any indication of the condition of the nerve at the seat of injury. Consequently a simple test with the faradic current gives us all the information we are likely to obtain about the fate of the nerve, and this is the all-important factor in deciding treatment and prognosis. The use of the ordinary induction coil has been very strongly condemned on account of the impossibility of standardizing the exact time relations of the discharge.[2] For purposes of research this objection is valid enough, but it has little force when we are

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[1] Lovett, "The Treatment of Infantile Paralysis," p. 70, 1916; Langley and Kato, *Journ. of Physiol.*, 1915, xlix, p. 432.

[2] Hernaman-Johnson, *Lancet*, February 19, 1916.

concerned simply with a clinical test. In this case all we need to know is that the coil we are using will not give a discharge long enough to excite a muscle with degenerated nerve supply. As we have seen, there is a wide difference between the durations required for nerve fibre and for denervated muscle fibre, and therefore the time constants of the faradic coil may vary over a considerable range without affecting the essential condition that the current should be too rapid to excite the muscle fibres directly. For this reason a knowledge of the exact time relations of the discharge is a matter of theoretical rather than practical interest. The induction coil has also been criticized on account of the difficulty of standardizing the rate at which the discharges are repeated. It is difficult to see the force of this objection. Apart from the fact that the contraction due to a number of discharges is more easily observed than that due to a single make or break shock, the muscle will respond to a single discharge as readily as it will respond to a series of discharges of the same strength and duration. The frequency of the discharges is scarcely ever rapid enough to bring about any summation of excitations,[1] and so long as this condition is observed the precise value of the frequency will be quite immaterial.

If we leave the fate of the nerve and consider that of the paralysed muscle, it is true that faradic and galvanic currents do not give all the information it is possible to obtain. The galvanic current will show whether the muscle is still capable of any response to stimulation, but unless its duration is controlled it will not show how rapidly the muscle is degenerating. The precise value of this information has been discussed already. It is in this connexion that the use of condensers may be an advantage. However, their application is not as simple as might appear at first sight. Indeed, there is very little to be gained from the statement that in one week the muscle will respond to a condenser of 1 microfarad capacity charged to 100 volts, and that in the next week it will only respond to a capacity of 1·5 microfarads at the same potential difference. Such a change might have been due to a lengthening of the chronaxie of the muscle, but it might also have been due to a diminution in the excitability brought about by an increased skin resistance or any other cause.

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[1] Lucas, *Journ. of Physiol.*, 1910, xxxix, p. 461; Adrian and Lucas, *ibid.*, 1912, xliv, p. 68.

Since the least effective duration of the discharge depends on the strength of the current relative to the rheobase (cf. fig. 1), it is absolutely essential to know not only the least capacity of condenser to which the muscle will respond, but also the relation between the strength of current employed and the strength required for a current of infinite duration. For practical purposes we should have to measure the threshold strength with a constant current lasting one second or more, and we could then use condensers charged to some definite multiple of this strength. If this precaution were not taken the results of successive examinations would not be comparable, because we should have no means of eliminating the effect of variations in the excitability of the muscle. The only other way to avoid this source of error would be to use very strong discharges in every case. As the current strength tends to infinity the curve becomes very nearly vertical, and therefore when very strong currents are used variations in the rheobase are of little importance. This method involves several practical difficulties, of which not the least is the danger of current spread to neighbouring healthy muscles. Even with these precautions there are several pitfalls in the way as Bourguignon has shown,[1] but it is nevertheless true that a method based on the use of condensers of different capacities should allow us to determine the progress of the muscle after the nerve supply is cut off, and might give information of great value as to the effects of treatment, though it is open to question whether it would not be simpler in the end to use the method of constant currents. For the purpose of deciding whether the nerve has degenerated or not, it is difficult to see that the condenser has any advantage over the simple faradic coil. Whether the nerve is growing towards the muscle or is prevented from regenerating by scar tissue is a problem which must be dealt with by neurological or surgical tests; the most elaborate electrical tests are quite incapable of deciding it.

It remains only to consider the electrical phenomena found in cases of incomplete nerve injury, contusion, compression and the like. As a rule these cases are readily distinguished by sensory tests and other neurological evidence. The strength duration curve may be of the simple rapid type corresponding to the

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[1] *Comptes Rendues*, 1916, clxii, p. 262.

excitation of nerve fibres, or else of the double type indicating a diminished excitability of the nerve relative to the muscle. In a few cases the nerve is much less excitable below the seat of injury than above it, and when this occurs the response to short currents is more readily obtained by stimulating above the level of the injury.

Theoretically it should be possible to measure changes in the conductivity of the nerve fibres not great enough to abolish conduction altogether. Such changes would not necessarily be accompanied by any alteration in excitability except in the immediate neighbourhood of the injury. In isolated muscle and nerve preparations a very small change of conductivity can be detected readily enough by measurements of the least interval for muscular summation with two stimuli separated by a short time interval. The reasoning on which this procedure is based may be found elsewhere,[1] and for the present it must suffice to point out that there are considerable practical difficulties in the way of such measurements in the human subject. A possible method of overcoming these difficulties is foreshadowed in Otto May's results with the Leduc commutator.[2] However, a method of this kind would involve a very searching analysis before any tangible results could be obtained.

For permission to publish these results I wish to thank the medical and surgical staff of the National Hospital for the Paralysed and Epileptic, Queen Square, and Lieutenant-Colonel Turner, officer in charge of the Connaught Hospital, Aldershot.

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[1] Lucas, *Journ. of Physiol.*, 1913, xlvi, p. 470 ; Adrian, *ibid.*, 1912, xlv, p. 403.
[2] *Brain.*

REMARKS ON THE CONDITION KNOWN AS TRENCH FOOT.

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Two hundred and forty cases of trench foot were admitted to hospital during last December and January. Many hundreds of cases were admitted to other hospitals during the same period, but I only had the opportunity of studying these 240 cases. I had had during the previous winter a not inconsiderable experience of this condition.

The worst cases came from G—— early in December, following the four days of severe rain and frost which were experienced at the end of November, 1915. The frost followed immediately on heavy rain storms. The cases on arrival in hospital were from five to twelve days from the time that symptoms of frost-bite were first noticed. Great numbers of men had to be evacuated from the Front, the hospital ships were necessarily crowded, and in the rush the locality became with its numerous hospitals and 20,000 beds one huge clearing station.

The following classification of frost-bite cases from the point of view of diagnosis and treatment was found of practical value at the hospital:—

Class I was represented by a number of patients who when seen had almost recovered from the effects of exposure to cold.

The feet were normal except for some tenderness and aching pain, chiefly at night. All that was necessary was to supply them with some thick, warm foot-gear and keep them in hospital for a time.

Pain and tenderness continued in some, though from physical examination no gross lesion could be detected; a neurotic element was undoubtedly present in certain cases, though the majority were genuine.

Class II. *Slight Cases: those that would be fit for Duty in less than two Months.*—On admission a patient of this class gave a history of swelling of the legs following the exposure to prolonged cold and wet. The swelling lasted for some days. It had now almost completely disappeared. As the swelling subsided severe pain described as rheumatism was felt in the legs. Walking was only possible with pain and difficulty, and when attempted

progression was effected by shuffling along the ward. Boots could not be borne. The feet and legs were at this time of nearly normal appearance, a little blue, or perhaps whiter than normal in places. Some of these cases had still œdema over the heads of the metatarsal bones. Small patches of anæsthesia were usually present on some part of the foot and above these patches areas of hyperæsthesia. The general condition was unaffected.

CLASS III. *Cases with Local Gangrene of Toes, or Toes and Heel, but without Constitutional Disturbance.*—These cases were often sent on to England at once in order to (1) make room for the admission of fresh and perhaps more urgent cases, and (2) because they would not be fit for service for some months.

The general condition of these men was good, though they were not quite well like those of Class I. They were quite fit for the voyage to England.

The type showed superficial patches of gangrene limited to the toes and heels. The toes were in some cases ultimately lost. The gangrenous process varied in depth.

Generally beyond the gangrenous areas and often separated from them there was some impairment of the circulation in the feet and legs, as evidenced by œdema, and patches or larger areas which were blue or white, and cold and anæsthetic. The anæsthetic areas in some extended up the leg for a considerable distance. Pain was conspicuous by its absence.

CLASS IV. *These Cases were all Septic and all had more or less Constitutional Disturbance.*—(*a*) In the slighter cases the toes were gangrenous, and pus was spreading into the sole of the foot, generally extending from the space between the first and second toes. In some the extension partook more of the nature of a cellulitis of the deeper tissues of the sole. The dorsum of the foot was œdematous, as were also the tissues around the ankle. The putrid odour from the feet was marked. The temperature was raised, pain was not severe, but the patient had no appetite and felt ill.

(*b*) The next series of cases comprised a group in which the condition was worse than that described under (*a*). The purulent infection had involved the whole sole of the foot and fluctuation was sometimes found on either side of the tendo Achillis. The dorsum of the foot was more œdematous and sometimes showed blebs. The œdema extended high up the leg. In some the posterior astragalo-calcanean joint was full of pus. The constitutional disturbance was severe.

(*c*) In the most severe cases the whole foot or the anterior half of it was obviously gangrenous, the skin being of a purple black or green colour and often mottled. The skin for some distance above the gangrenous part was of a dull red colour. When the foot was not in outward appearance wholly gangrenous, yet on incising the skin the cellular tissues and muscles were often grey in colour and obviously past recovery. In all these cases the metatarso-phalangeal joints were involved; also generally the cuboid-metatarsal joints and sometimes all the other joints with the exception of the astragalo-scaphoid and ankle joints. The spreading cellulitis around the tendo Achillis had often followed the line of the tendon into the deep parts of the back of the leg. The leg was œdematous as high as the knee. The temperature was 104° F. or 105° F., and in the worst cases of all, drowsiness, dry tongue, and slight albuminuria, all due to septic toxæmia, were observed.

Treatment.—All the cases on arrival had suffered from cold and wet several or many days previously. The primary condition was not observed and treatment in Malta was, therefore, directed to the later stages of frost bite.

Classes I and II.—These cases were very similar to those which I had to care for during the winter of 1914-15. The cause then was not due to the effect of severe frost but to long exposure to cold and wet.

It is to be noted that this exposure in all cases produced changes in the blood supply and in the innervation of the feet and legs. While the vascular obstruction remained obvious, little pain was experienced, and when it subsided pain and other nerve conditions became manifest. It was obvious that the frost had affected not only the vessels, but also the nerves of the feet and legs.

The damage to nerves persisted long after all other changes in the limbs had been recovered from—in other words regeneration of nervous tissue is a longer process than that of other tissues.

In the majority of cases the only treatment that seemed to be really useful was loose, warm stockings, overlayers of wool, and foot coverings made of thick, warm, soft material, which came well above the ankle. In only a minority of cases anodyne applications, such as lead and opium, or stimulating greasy applications such as lanoline and turpentine, were of any service. Gentle massage was useful in some cases, but in others it could not be borne.

Time was the essential factor in the cure of the signs and symptoms depending on the changes taking place in the nerves, and while treatment could ameliorate the condition, time alone could cure it.

Class III.—These cases may be divided into two groups: (*a*) The *dry gangrene* cases were in the minority. They were treated just like dry gangrene in civil life—i.e., the attempt was made to keep them dry and free from sepsis. The parts were soaked daily with alcohol and dressed with boracic acid or some other powder and cotton wool. When first admitted the toes and feet were very carefully cleaned with ether soap and then with turpentine or ether; (*b*) the *moist gangrene* cases were really only cases of foul septic wounds accompanied by some changes in the vascular and nervous systems. The most effective dressing was the use of a solution of iodoform in ether, 1 in 10, or the use of gauze soaked in eusol. Sometimes the former was used to wash the wound and then the eusol dressing was applied. This treatment was often observed to cause the moist wounds to take on much the same appearance as those grouped under the heading "dry gangrene." In other words the septic condition was mastered.

The dead skin and subcutaneous tissue of the affected toes and heel separated, exposing a healthy granulating surface. This healed readily under eusol dressings and under treatment by red lotion or resin ointment.

When all the tissues of a toe were involved, a line of demarcation formed at the base of the toe. The toe was then disarticulated at the metatarso-phalangeal joint—usually no anæsthetic was required. The stump healed over quickly.

When the gangrene of the heel reached a deeper level than the superficial fascia, the period of healing was much delayed, sloughs of the soft parts and occasionally a superficial sequestrum of the os calcis separated before the wound could heal.

Class IV.—These cases on arrival were not cases of frost-bite, but were cases of spreading gangrenous cellulitis. In the infective gangrenous cellulitis of the lower extremity which the surgeon has to treat in peace time there is no disease of the vessels and nerves such as was present in these cases. The principles of treatment remain the same, but the war cases yield less easily to treatment because the infective cellulitis is complicated by a condition which weakens the resistance of the tissues.

In this class of case treatment was carried out on the following lines:—

(1) For œdema, cellulitis, and local abscess formation, *free incision*.

(2) For hopelessly gangrenous cases, *amputation*.

(3) *Antisera and vaccines.*

(4) Certain intravenous antiseptics—such as ten cubic centimetres of 1 in 1,000 *perchloride of mercury*, 100 cubic centimetres of *eusol solution*.

(5) *Ample nourishment and stimulation.*

(6) Frequent moist *dressings* and in some cases *baths*.

An incision into a definite fluctuating swelling deep along the inner border of each foot in one case caused rapid convalescence; in fact, whenever an abscess was opened improvement was always assured. The bad cases, as might be expected, were those in which the condition was a spreading grey gangrene of the cellular tissue without local abscess but with much œdema. Free incision into this œdematous cellulitis was not as fruitful of improvement as in the spreading cellulitis where the vessels and nerves were not affected, and often yielded disappointing results.

In the sole of the foot when the latter was much swollen it was often difficult after a most careful examination to say whether a local abscess or cellulitis was present. It did not much matter as free incision in either case was indicated, unless it seemed better to amputate.

Amputation.—All cases improve, some marvellously, after a short time in hospital with good nursing and food. There is never any justification for an immediate amputation. Even when amputation is subsequently necessary, a few days in hospital greatly improves the local condition and general condition of the patient and fits him for the shock of the operation. Cases which appear to need a high amputation when admitted may, in a few days, require no amputation at all, or only a peripheral one. If amputated at the moment of admission such cases with high fever and much exhaustion are likely to die, though if no operation is done they may still die in a day or two.

The usual plan of performing a formal amputation and the cutting of classical flaps should be set aside by the surgeon in considering the site and type of operation to be carried out in many of these cases. The object in view is to place the patient in such a state that the immediate risk to life is diminished. At some later date, when the general condition is good, it will be time enough to consider whether the stump can be improved, as will often be the case, by some further operation.

No one of experience, seeing the result of some of the operations, would condemn them because the bone was not properly covered, or because it offended the eye by not being planned on text-book lines.

It has been mentioned that, when the toes were gangrenous, with little assistance by way of operation they came away at the metatarso-phalangeal joints and healing took place. The result was a useful foot.

When the foot itself was involved the question of the amputation to be performed varied with the extent of the cellulitis or gangrene present. Satisfactory flaps could not always be cut on classical lines. One Lisfranc and one Chopart amputation were done. The Chopart amputation gives, as I am informed, a useful stump, if the nerves are cut short. If the nerves are not cut short the patient walks on them, as there is no arch to the foot, and of course the stump becomes painful, pointed, and unsatisfactory.

The Syme amputation was not always satisfactory since the suppuration in the sole has a tendency, as already described, to spread to the region of the tendo Achillis, and so the heel-flap was prone in part to perish. This did not necessarily mean another amputation, but all that was required was the resection of one to two inches of the tibia and fibula, when the bone could be easily covered. In some of the cases a higher amputation would have been better than the one performed, but it was done to save as much of the limb as possible, especially when both feet were gangrenous and deep cellulitis was sometimes discovered at the operation at a higher level than it had been previously suspected.

Amputation through the lower third of the leg was necessary when the gangrene involved the whole of the foot and lower portion of the leg. When the operation could be performed through tissues which were not œdematous to a very marked degree, without sacrificing too much of the limb, recovery and healing were comparatively rapid.

Circular, equilateral flaps, and modified flap and circular methods for amputation of the leg were all employed. For both speed of operation and after-results the latter form of operation was good. A circular incision was first made round the circumference of the limb, including skin and subcutaneous tissues down to the muscles, then an anterior and posterior vertical incision of 1 inch or 1½ inches so that two short lateral flaps were formed at the distal end of the circular amputation. These short incisions in the flap of a circular amputation were helpful in exposing the remaining tissues to division and the posterior one facilitated drainage. The muscles and tendons were divided at a rather lower level than the bones, and care was taken to cut the nerves short. Thus there was no unnecessary sacrifice of any portion of the limb in the formation of

classical flaps. The operation could be performed quickly and a good stump resulted. Few or no stitches were inserted, so that ample drainage should be provided; one stitch was often sufficient to prevent retraction of the flaps.

Scheme of Amputation.—(1) Open ether was used for the anæsthetic so long as the lungs were healthy. An injection of atropin $\frac{1}{150}$ grain, morph. tart. $\frac{1}{6}$ grain was given half an hour previously.

(2) The limb was thoroughly cleansed and shaved at the proposed site for operation, careful washing with ether soap being followed by the application of ether. When quite dry it was painted with a two per cent solution of iodine in rectified spirit. A bandage which had been previously soaked in 1 in 20 carbolic acid was wound round the gangrenous portion, which was then covered with a sterilized towel.

(3) Ten minutes before the operation was commenced the great sciatic was injected with a four per cent solution of eucaine. In some cases, too, the skin and muscles just above the operation area were injected with the same solution.

(4) Up to 2½ pints of normal saline were infused either subcutaneously or intravenously at the same time as the operation was taking place; in some cases intravenous antiseptics were added to the infusion.

(5) Subcutaneous injection of thirty cubic centimetres of polyvalent antistreptococcal serum was given at the time of the operation.

(6) Great care was taken to keep the patient warm during and after the operation. In the worst cases special nursing, heart stimulants, and food were all-important during the first three days. By these means post-operative shock was reduced to a minimum, and was entirely absent in some of the very worst cases.

Antisera and Vaccines.—Polyvalent antistreptococcal serum was of great service in many cases where a streptococcal infection was present. We gave 30 cubic centimetres as the first dose, followed during the next twenty-four to forty-eight hours by two or three doses of 20 cubic centimetres or 10 cubic centimetres. Some cases showed marked improvement after the use of this serum.

A prophylactic dose of *antitetanic serum* was given soon after admission in all cases in which there was a wound. We had one fatal case of tetanus where a severely frost-bitten foot was the site of infection. This patient was admitted with tetanus and died twelve hours after admission. He had not had any antitetanic serum.

Vaccines were especially useful in some cases of the fourth class in which the suppuration was chronic, and the process of repair had come to a standstill. In these cases the use of an autogenous vaccine produced remarkable results and rapid healing. In cases with septicæmia a blood culture was always taken and if an organism was isolated a vaccine was employed. A stock vaccine should be used till the autogenous vaccine is ready.

Intravenous Antiseptics.—These were used at the time of operation and in some cases the injection was repeated a second or third time at intervals of several days. The perchloride of mercury seemed to be very useful in some cases, and certainly seemed to be of more value than intravenous eusol.

Prophylaxis.—Loose-fitting watertight boots should be worn over two pairs of thick warm socks. I have heard it recommended that the feet should be kept smeared with some greasy preparation and I imagine that this precaution would be of use in preventing the effects of cold and damp. The feet should be kept as clean as possible, so that if frost-bite occurs infection will be less likely to follow—this, however, is not easily managed in trench life.

Regular physical exercise to maintain the tone of the vascular system is the finest preventive, but it is not, however, easily obtained under existing conditions of trench life during winter. When I was in France I found that frost-bite was least common in those regiments which occupied the best trenches. The reason, I believe, should be less attributed to the slightly more habitable conditions than to the regular amount of work done by these men in repairing their trenches under cover of darkness every night. Massage of the feet every night is a form of exercise which would have very beneficial results.

The wearing of puttees predisposes to frost-bite because they constrict the legs, more especially when they become damp and the material shrinks. In many of the worst cases admitted puttees had been worn. They were soaked in water and then froze on to the limbs. No wonder gangrene occurred.

Some Notes of a few Typical Cases illustrating Examples of the Different Classes of Frost-bite.

Class II.—Pte. B., December 6: Admitted to hospital suffering from frost-bite. Both feet were blue, slightly œdematous and painful. No lesion of skin. The feet were thoroughly washed and dried, dusted with boracic powder and loosely bandaged over a thick

layer of cotton wool. Patient complained of considerable pain at night, which prevented him from sleeping. On December 10 the swelling was subsiding and pain less troublesome. December 30: The œdema had disappeared and the patient was walking about the ward. He complained of a good deal of pain after walking for any length of time. Improvement had been steady but very slow. January 17 : Progress very slow, patient transferred to England.

Class III. "A."—Private C., admitted December 13, 1915. Frost-bite affecting all the toes of both feet. The toes were gangrenous but dry. They were shrivelled and black in appearance with a well-marked line of demarcation along the proximal end. Above this the tissues of the foot were slightly œdematous. Temperature normal: very little pain. The wounds were dressed with iodoform in ether solution. December 23, 1915: Some of the toes disarticulated. January 11, 1916: Transferred to England; wounds granulating, clean and almost healed.

Class III. "B."—Pte. B., December 3, 1915: Admitted to hospital. The toes of both feet were black and gangrenous. The feet were œdematous and blue with a large superficial ulcer on the dorsal aspect of each foot. Both feet were anæsthetic. The odour from the feet was most offensive. Temperature 104·2° F., but the general condition was not proportionately affected. December 13, 1915: Temperature only rising now to about 100° F. every evening. The œdema is gradually diminishing and the feet, except for the toes, are now white. The toes were separating and suppuration was present at the line of demarcation. Dressings: Eusol fomentations and the application of iodoform in ether solution. December 20, 1915: All toes of both feet disarticulated. The œdema is steadily decreasing—general condition is considerably improved. January 10, 1916: The wounds are almost healed, though some œdema is still present. The feet are almost completely anæsthetic below the ankles. Patient has had an attack of malaria. January 12, 1916: Transferred to England.

Example of a Case of Local Abscess in Foot, Incision, Recovery; simulating Gangrene.

Class IV.—Pte. W., admitted to hospital December 8. Great œdema of both feet and legs, the feet below the ankle are of a greeny black colour and mottled. Above this the legs are white and the skin glazed on account of the amount of œdema present. Both feet are anæsthetic to superficial and deep sensation. A very foul smell comes from the feet. Temperature 104·8° F. and the

condition is most toxic. On the inner side of the left foot, just below the head of the astragalus, definite fluctuation is felt; on the right foot it is doubtful whether any fluctuation is present or not. An incision on $1\frac{1}{2}$ inches in length was made over the site of the fluctuation on the left foot. This was deepened till the under surface of the tarsal bones was reached through more than an inch of boggy œdematous tissue; then, by thrusting a pair of sinus forceps deeply into the sole of the foot, at least an ounce of thick pus was found; a drainage tube was inserted. The right foot was similarly dealt with, about one tablespoonful of pus being evacuated. No anæsthetic was required and the patient experienced no pain whatever. The next morning the patient's general condition was greatly improved, temperature normal. The feet steadily improved. He left for England on December 31, having lost only two toes of one foot from gangrene. A small amount of œdema was still present and sensation was gradually returning in the feet.

Class IV.—Pte. L., December 8, 1915: Admitted to hospital. Both feet black and gangrenous up to ankle-joint, œdema of legs. Blebs on feet. Line of demarcation at level of ankle-joint with considerable separation of tissues and sloughing tendons visible. General condition very toxic; temperature 104·4° F. December 15, 1915: Slight improvement in general condition. Swinging temperature up to 103° F. Separation of deep structures taking place rapidly at line of demarcation. Feet in sloughing condition with crepitation in joints. Left foot disarticulated at ankle-joint, a heel flap being formed. No sutures inserted. Intravenous saline with ten cubic centimetres of 1 in 1,000 perchloride of mercury. The flap sloughed a few days later. December 18, 1915: No improvement. Right foot disarticulated in similar manner but no flaps formed. December 28, 1915: Marked improvement. The temperature is falling and the stumps are cleaning. January 25, 1916: Transferred to England quite convalescent. Both stumps clean, granulating and rapidly healing.

Class IV.—Pte. H., December 6, 1915: Admitted to hospital, pale, emaciated, considerable pain; temperature 101·8° F. Both feet and lower part of legs œdematous, anæsthesia over these areas. Most of the toes gangrenous and septic. Superficial patches of gangrene on dorsum of each foot and both heels. December 8, 1915: Considerable pain, temperature goes up at night to 101° F., gangrenous patches on feet and heels separating. December 23, 1915: A number of toes amputated. Incisions

made on inner sides of both feet, and serum but no pus evacuated. Intravenous saline with fifteen cubic centimetres perchloride of mercury. December 27, 1915: Swinging temperature up to 100° F. Sloughs removed from both feet on exposing os calcis. Local abscess on right foot. Still much œdema. January 3, 1916: Left foot worse. Amputation through lower third of left leg, all the tarsal and metatarsal joints of foot were affected. January 16, 1916: General improvement. A quantity of pus draining from right foot. January 27, 1916: Temperature still reaches daily 103° F. Big toe disarticulated and abscess opened on outer side of right foot. February 4, 1916: Temperature unaltered. One abscess of foot and another of stump opened and drained. February 6, 1916: Treatment by vaccine commenced. March 10, 1916: The foot and stump were healing. Still a little œdema. Temperature 99°-100° F. in the evenings. Transferred to England.

SHELL SHOCK STAMMERING AND OTHER AFFECTIONS OF VOICE AND SPEECH.[1]

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Shell Shock Stammering.

The stammer which has its origin in shell shock is in my experience one in which there is chiefly difficulty in the production of the voiced consonants and vowel sounds, and is one which does not present the general difficulties met with in the ordinary stammer. It may be described as a more or less severe inhibition of the speech, and it is accompanied in some cases with amnesia or the forgetting of words which obviously are required and for which other words are substituted. The condition is very suggestive of the type of aphasia known as aphemia, with which I will deal later. The prognosis of such cases is good, and in mild cases it is best to leave the trouble quite alone, and as the patient's general condition improves the stammer disappears. In more severe cases instruction should be given, and as a preliminary the patient should be taught to fill the lungs in a proper manner. This is brought about by the acquirement of an inferior lateral costal expansion during inspiration and during expiration the abdominal muscles must contract slowly and strongly, so that the diaphragm is pressed upwards by the abdominal viscera and the lower ribs drawn downwards and inwards and the air expelled from the lungs definitely and adequately. This latter action I describe as the motive power of the voice, and I train the patient to rely upon it very much indeed as he speaks. The steady breathing produces a sense of repose in the stammerer and the emotions of nervousness and anxiety yield very readily to it. One also impresses upon the stammerer that any raising of the upper chest or tensing of the muscles of the throat, tongue, and jaws, is fatal to the acquirement of normal speech. The method of breathing which I employ is fully described

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[1] A paper read at a meeting of the Medical Society of London on December 12, 1916.

in the *Transactions of the Medical Society of London*,[1] in the June number 1916 of the *Royal Army Medical Corps Gazette*, the *Lancet* of October 2, 1915, and elsewhere.

The next step is to teach the main vowel sounds and their resonator positions which means the correct position of the tongue and lips and the distance between the teeth for each main vowel sound. When the sounds are correctly shaped for, the fullest resonance is given to each sound by overtones and harmonics being produced to their fullest extent with the greatest possible ease. The main vowel sounds are OO, OH, AW, AH, A, EE. A general description of their positions is that the lips are forward, the tip of the tongue near the lower teeth and the distance between the upper and lower teeth is from $\frac{1}{8}$ inch for OO to two inches for AH: for A the teeth nearly meet, and for EE the teeth are touching. These same sounds combine in six ways: (1) AH and OO as in the word "sound"; (2) AH and EE making the long "I"; (3) AW and EE as in "boy" (4) OH and OO as in "road"; (5) A and EE as in "rain" and "fair"; (6) EE and OO as in "new" and "you." A third and last group is formed by words in which no main vowel sounds or compound sounds appear. Such words are placed either on the open AH position or the closed EE position, e.g., words like "long," "on" "have" "not," "from," "abbot," "love," and "among," are on the position of AH, and words like "little," "it," "ring," "sister," "first," and "minister," are on the position of EE. This arrangement affords an extremely easy and practical way of learning the vowel positions in nearly all words and is quite sufficient for all practical purposes. The consonants are divided into two classes—the "voiced" and the "breathed." The "voiced" consonants are produced with vibrations in the vocal cords and must be produced slowly so that, during instruction, the vibrations are distinctly heard. The "breathed" consonants are produced quickly and lightly, and the vowel sound in the word immediately sought for. The "voiced" consonants are B, D, G, J, L, M, N, R, V, W, Y, and Z, and of these consonants the W is the OO sound and Y is the EE sound. The "breathed" consonants are C, F, H, K, P, Q, S. T. All this knowledge is very easily acquired, and with a little practice the correct production of the vowel sounds and consonants is automatically performed. Generally this amount of instruction on vowel sounds and consonants combined with steady practice in

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[1] See paper on "Gun Shot Wounds of the Chest," by C. MacMahon, in vol. xxxix of the Society's *Transactions.*

breathing exercises is sufficient for a stammerer who has only commenced to stammer from shell shock and has not acquired the physical disabilities which supervene in a stammer of long standing.

There are also a large number of stammerers whose stammer has been seriously intensified by shell shock or wounds, and whose stammer has existed since childhood; and there are other stammerers whose affliction has been overcome but has been resuscitated by the same causes. These cases are very much more difficult to deal with, and the instruction must necessarily be much more definite and takes a considerable time. Several alliterative examples must be given for each of the consonants which must be regularly practised and the vowel sounds taught by examples of them being given in many ways, so that in every word they are instantly recognized. There must, however, be no mental strain in learning what is necessary, it must be taken in slowly and gradually absorbed.

In stammerers of a severe type the throat muscles are hard and tensed and the tongue so drawn up at the back that it is almost in contact with the soft palate—all this must be overcome before much improvement can be sought for. Stammerers are often given very bad advice and the worst is to take a long deep breath, without explaining what correct breathing is, which they are told will make speech quite easy. The long deep breath almost invariably results in the stammerer raising the upper chest, overloading the upper part of the lungs and tensing the throat muscles; speech is thereby made an impossibility. If these efforts are persisted in the stammer is made very much worse.

Stammerers vary very much in the type of their stammer, their demeanour and sensitiveness. Generally speaking the laryngeal type of stammerer, i.e., the stammerer who has difficulty in producing the vowel sounds and voiced consonants is more easily cured than the stammerer who rapidly repeats introducing consonants and whose type of trouble is known as stuttering. In practically all types the treatment is both mental and physical but naturally the need of either form, in particular, is more strongly indicated in some stammerers than in others. In some cases the marked lack of control of the emotions is the exciting cause of the stammer: in other cases the emotions are well under control and the stammer is almost entirely of a physical nature.

It may be of interest to mention a few cases treated by this method.

(*a*) A young officer whom I had previously successfully treated

when he was a school boy relapsed after being twice wounded. His impediment was of the laryngeal type and when spoken to he was often quite speechless. He was anxious to pass into the Regular Army from the Reserve of Officers to which he was attached, but his stammer prevented it. I saw him nine times and he improved so rapidly that he then applied for a Medical Board to have his speech tested. In spite of this trying ordeal he came through it most successfully and was passed into the first battalion of his regiment.

(*b*) An officer, a patient in Londonderry House, wounded on September 7 last, began to stammer within a few minutes of receiving his wound. I saw him on September 28 and gave him full instructions in breathing and vowel sounds. The stammer was of the laryngeal type and there was also difficulty with the letter T. Unfortunately he had to go away for special treatment in connexion with his wound, but he wrote to me on October 23: "My speech has greatly improved and I may say with the exception of a very slight stammer, is restored."

(*c*) An officer, a patient in Moray Lodge, was blown up by a shell on April 29. A stammer supervened. When first seen on November 8 his throat muscles tensed very much and the breathing was very irregular. The speech was slow and he checked very much on the voiced consonants. He is now practically normal in speech and there is very seldom the slightest difficulty in speaking. He is still under treatment but in a week or two will be completely cured. I asked him what had helped him most in his recovery and he replied that it was the proper breathing, because he could always make himself quite quiet and free from anxiety when applying it.

(*d*) An officer whom I had previously treated for a severe all-round stammer before the War came and reported to me within the last fortnight that, although he had been through heavy fighting in France and was in the Serbian retreat, he never had the smallest trace of a stammer.

(*e*) When in a ward at St. Bartholomew's Hospital a few weeks ago a private soldier asked to see me. He told me I had treated him for a stammer at the Hospital a few years ago, since when, and although he had been badly shot in the face during the War, there was not the slightest evidence of his former impediment.

Aphasia.

The cases of aphasia that I have treated have nearly all exhibited a type of motor aphasia called aphemia in which the faculties of

hearing, writing and reading were normal but speech was either practically non-existent or was only produced with great difficulty. The memory was as a rule rather defective, but not seriously so. These patients must be taught the same method of breathing as in stammering and as can be imagined the correct breathing, with its calming effect on the emotions, has a great deal to do with recovery. The patient suffering from aphemia has a misconceived idea as to how voice is produced and consciously or sub-consciously tries to get the voice by physical effort, and as a sound is attempted one notices his muscles are tensed everywhere and after he has with difficulty produced a simple sound or word he is quite exhausted with the effort. The treatment, therefore, is to get as complete muscular and mental relaxation as possible, to explain that voice is a matter of resonance in the head and chest, and that it only originates in the vocal cords, and then to start on the simple vowel sounds which the patient generally produces in a few minutes. Then simple words like "sister," "nurse" and "good-night" are learnt. Then comes a time in some cases when the patient has so far recovered from the original cause of his trouble that normal speech really is possible if only relaxation of effort can occur. This accounts for the dramatic return of the speech of which one occasionally hears. The undue effort made sets up a hyperæmia of the brain which is just sufficient to prevent speech being normal and when the patient unconsciously relaxes this effort he immediately speaks quite normally. This kind of recovery is not the normal course that this type of aphasia follows and the recovery is generally steady and rather slow.

I would like to mention two cases which are, I hope, of interest:—

(*a*) A private soldier, a patient in St. Bartholomew's Hospital, had been blown up by a shell and when I saw him he was quite speechless. After explaining what I required him to do he could within a few minutes produce vowel sounds with difficulty, and as time went on he was able to say a few simple words. I was told that he had asked in writing if he might have a tooth extracted, as he had read of recovery of speech in a similar case to his own by such means. I assured him he could recover his speech without that operation. His general condition greatly improved and I told him, after seeing him three times, that his speech would probably return immediately if he would get complete relaxation of effort. Shortly afterwards when playing cards he said, "That is my card," and from that moment his speech was quite normal.

(*b*) An officer in No. 1 London General Hospital was wounded

under the left eye on October 7, 1916. His speech became affected five days later in a casualty clearing station. When I saw him on November 5, he spoke with very great difficulty and was quite exhausted after saying a few words. I found that he, as in other similar cases, was tensing all his muscles as speech was attempted. I gave him advice as to breathing and how to relax the abnormal efforts he was making. On November 12, he spoke with more freedom and said to me, "I am getting a bit better," and, "I feel I must keep quiet and it comes after a bit," "I think far quicker than I can speak." I asked him what had helped him most, and he replied it was the breathing. On the 15th, he spoke in rather a staccato voice, but his words did not check in the way they used to and on his discharge about a week later there was still further improvement and he should soon make a complete recovery of his normal speech. (P.S.—I saw this patient again on January 17. His general condition and speech were both excellent.)

(*c*) The following is a case treated by a nurse who was present at a lecture I delivered in December, 1915, and who has kindly written me spontaneously about the case. Her letter says: "I have been ordered to treat several patients suffering from shell shock; one of them has been dumb for several weeks. . . In all points your directions were followed implicitly. After four treatments, rather slow, distinct, voluntary speech was obtained. First he made no sound, but breathed as directed; next came a grunt and vowel sounds, then consonants and short words such as "bar" "see" "go" "do" "by." He said the words after me with plenty of lip action, but could not do so unless I spoke first. Finally came a short sentence uttered voluntarily. I describe the progress at risk of being tedious, so that you may know your kind help was not wasted. . . . There has been no return of the nervous condition since he resumed military duty."

Functional aphonia is treated in various ways and chiefly by electricity. The methods I use are described fully in the *Lancet* of March 1, 1913.

I always explain to the patient what the condition of the cords is and tell him how I want him to breathe as I attempt to get the voice back. I explain that in the aphonic condition the air from the lungs is being forced through a tensed throat and then articulated, and that, instead, muscular relaxation and vibrations must be brought about. I then press the back of the tongue down with the two middle fingers of my right hand, using a good deal of pressure and hold the tongue in that position from one to two

minutes. I repeat this and at the same time use my left hand on the throat and gently squeeze on the back of the thyroid cartilage, at the same moment asking the patient to try to make the sound of "ah" on as deep a note as possible. If there are no vibrations I tell him to cough, and as he coughs to finish the cough on the "ah" sound. The voice often returns immediately, but if it does not I ask the patient to use a tongue spatula himself and to continue it assiduously until he can get vibrations, and until I see him again. Up to the time of the War I had treated a large number of cases successfully with very few failures, but since the War I have not been quite so successful. I think the cases now are more difficult because the original cause of the aphonia is much more severe among soldiers than among civilians, and also the treatment is often attempted too soon after the aphonia has come into being. The cure of functional aphonia is very much easier to accomplish in a long-standing case than in a recent case, and I would very much prefer to treat a case of six months standing than one of six weeks. My strong belief is that for soldiers suffering from functional aphonia due to shock the best method of treatment is at first complete rest in hospital, so that the general condition is improved; then for them to go to a convalescent home and to attend as out-patients at a hospital where the necessary treatment can be given. I would again emphasize my strong conviction based on a fairly long experience, that the longer the aphonia has existed the easier is its cure, as one is getting further away from the original cause of the loss of voice.

The following cases of functional aphonia are typical of others:—

(*a*) A private soldier was sent to me from the Minley Military Hospital, Farnborough, to St. Bartholomew's Hospital, suffering from complete aphonia of some months standing. I failed at the time to get the voice back, but I judged from what I could hear in the larynx that the voice would soon return. I saw the patient on a Thursday and advised that, if my treatment be carried out regularly, the voice would return early in the next week. The Matron of the Hospital wrote to me as follows shortly afterwards: "You asked me to let you know how Private B. got on after seeing you. I am very pleased to be able to tell you that his voice came back by degrees from that day, and, as you said, by the following Tuesday he could speak quite well, although in rather a high-pitched voice, but I think he has never really had a very deep one."

(*b*) An officer who had been shot through the back of the neck

on February 2, 1915, developed functional aphonia three weeks later. On May 18 of the same year he was sent to me by Dr. Lambert Lack, who kindly asked me to treat him. I saw him twice; on the first occasion he got very definite vibrations. Four days later the voice was full and resonant and a week later he was able to sing in a deep bass voice.

(P.S.—On December 13, 1916, an officer was sent to me from the Hospital at 12, Belgrave Square, by Dr. Blackett on the advice of Mr. Harold Barwell. He was completely aphonic following acute laryngitis. I saw him in the morning; vibrations returned in a few minutes and by four o'clock in the afternoon his voice was perfectly normal. On the following day an almost identical result occurred in a patient at No. 1 London General Hospital, whom I treated there.)

I will now briefly describe one or two cases which may be of interest.

(1) *Severe Injury to the Larynx and Vocal Cords.*—An officer, a patient in No. 1 London General Military Hospital, was shot through the throat and the arytenoid cartilages destroyed on August 24, 1916. Captain Ernest West, R.A.M.C., asked me to treat the case vocally and has kindly supplied the following note on the case: "Lieutenant J., shrapnel wound of neck involving larynx. Jagged piece of shell entered about tip of right greater cornu of hyoid and passed downwards and to left through the larynx, lodging behind left lobe of thyroid. Larynx tilted to left, arytenoid region entirely replaced by scar, glottis fixed. Anteriorly composed of immobile bands of scar stretching antero-posteriorly and webbed anteriorly; posteriorly a fixed irregular triangular gap representing pars respiratoria. Voice a hoarse whisper only. After instruction rapid alteration in voice and acquirement of a gruff voice with plenty of tone in it, easily heard the length of a hospital ward. I consider the case a very striking success."

The treatment I gave was as follows, and it was on exactly the same lines as the treatment I use in cases of intrinsic cancer of the larynx, where after operation one cord or part of cord remains.[1] I developed the sterno-thyroid and sterno-hyoid muscles and made the larynx sink in the throat. This action had the effect of relaxing what little of the cords was left, thereby getting vibrations. These

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[1] See description of a case treated by C. MacMahon, reported in the *Proceedings of the Royal Society of Medicine* (Laryngological Section), vol. v, p. 154, and vol. vi, p. 132.

vibrations were amplified by the resonator positions of the vowel sounds being acquired with the aid of very definite breathing.

(2) *A Case of Gunshot Wound of Hard and Soft Palates.*[1]—In this case the patient had been shot through the throat on May 15, 1915, and the bullet had torn its way through the hard and soft palates, causing serious injury. The case was treated at the Croydon Military Hospital, and the palates were most successfully repaired, and a most ingenious artificial velum fitted.

The speech, however, was very like that of a congenital cleft-palate patient. The air was entering markedly into the nasal cavities, and the consonants "D" and "T" were affected; "CH" and "J" were very difficult of production, as were "S" and its combinations with "T," as in "strike," and with "P," as in "speak."

It will be noticed that the consonants affected were anterior linguo-palatals. I first got the back of the tongue to descend by training the sterno-thyroid and sterno-hyoid muscles to contract very strongly and by the use of a tongue spatula. The back of the tongue and the soft palate work in sympathy, and when the back of the tongue is high, the soft palate is low and vice versa: this is so in normal conditions, and in this case, as the soft palate was contracted after repair, it was unduly low, and the tongue correspondingly high. By sinking the back of the tongue and the floor of the mouth, the soft palate was elevated, and the over-supply of air was cut off from the nasal cavities. The cause of the weak production of the anterior linguo-palatal consonants was that the front part of the tongue was not free in its movement on account of its contracted condition at the back, but when this was corrected it soon resumed its normal functions, and the man spoke well; but I ought to point out that he was greatly helped by the artificial apparatus, which was so successfully fitted at the hospital. A general rule in these cases is therefore to sink the back of the tongue and the floor of the mouth by developing the sterno-thyroid and sterno-hyoid muscles, and to re-educate the tongue in its movements where it has become deficient. In very severe cases where the roof of the mouth has been damaged beyond repair, I have noticed wonderfully good speech, which has been entirely due to the fitting of obturators by dental surgeons.

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[1] For full description of the treatment of the cleft palate speech, see chapter by C. MacMahon in Sir Arbuthnot Lane's new edition of "Cleft Palate and Harelip," and also Sir Watson Cheyne's and Mr. F. F. Burghard's "Manual of Surgical Treatment," vol. iii.

(3) *A Case of Head Injury with Resulting Impairment of Speech.*—In this case the patient had received a severe wound in the right eye, which necessitated the removal of the eye, and there was extensive bruising round the eye-socket, the upper lip was paralysed, the speech was very blurred, and, except for simple words, it was very difficult to follow. The "S," "K," and "G" were not present, and the speech, as a whole, resembled that of a person suffering from the effects of apoplexy. I saw him first on July 19 of this year, and I wrote out the main vowel sounds, and got him to repeat them after me. I then taught him to put the consonants in front and after them. In a week's time there was great improvement, and I then wrote out some verses for him to say, introducing the main vowel sounds. In a fortnight's time he was speaking quite normally, except that the speech was rather slow, but all the consonants were produced accurately; after a month the speech was perfect.

These are some of the cases that I have been brought into contact with in connexion with the War. If my experiences are of any help to others, I shall be very thankful. I must express my deep gratitude to the many members of the medical profession, by whose kind help I have been enabled to treat the cases, and, in conclusion, I should like to say how much I appreciate the great honour of being allowed to speak before this Society for the second time within a year.

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POTASSIUM PERMANGANATE IN THE TREATMENT OF ANAEROBIC INFECTION OF WOUNDS.

(*A Preliminary Note.*)

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If the projectiles themselves be excluded, the chief danger to the soldier in France and Belgium arises from the activity of anaerobic facultative parasitic micro-organisms, more particularly the *Bacillus aerogenes capsulatus* (*B. Welchii*). It is the prevention and control of infection by this bacterium that forms the chief problem for surgeons working in casualty clearing stations.

During the past year the author has employed potassium permanganate in the dressing of severe lacerated wounds, and has critically compared its effect with that of other antiseptics. It is because the writer is convinced that in this germicide we have at our disposal a very valuable prophylactic and curative agent, and one deserving, at least, a more extensive trial by other surgeons, that this note is published.

In the treatment of severe lacerated wounds certain operative and mechanical procedures are essential; these comprise :—

(*a*) Arrest of hæmorrhage—vascular and capillary.

(*b*) Provision for the evacuation from cavities of blood and transudates; adequate drainage.

(*c*) *Excision of all obviously devitalized tissue*, whether such tissue has been killed by the force of the projectile, interference with blood supply, or by the activity of gangrene-producing micro-organisms.

(*d*) Proper posturing and adequate splinting.

(*e*) Conservation of circulation.

In many, perhaps the majority of cases, such treatment will suffice; and, unless these measures are conscientiously carried out, supplementary treatment will avail but little. There is, unfortunately, a large percentage of cases in which, owing to various causes, these operative and mechanical measures prove inadequate, and for which some solution having a bactericidal or inhibiting effect upon the bacilli must be employed.

It is not the author's intention in this note to contrast the effect of solutions of potassium permanganate, eusol, hypertonic saline,

etc. Both eusol and saline solutions have been employed, but owing to the satisfactory results obtained with permanganate this preparation has been made use of with increasing regularity.

Reasons for the employment of potassium permanganate in the dressing of severe lacerated wounds and of gas gangrene infection may be tabulated as follows:—

(1) It is inexpensive, even at its present increased price.

(2) It is a powerful oxydizing agent.

(3) It is an effective germicide (even in dilutions much greater than may be profitably employed).

(4) It is astringent, thus acting as a hæmostatic, minimizing oozing and controlling the development of interstitial œdema.

(5) It does not macerate epithelium nor other tissues.

(6) It is a mild irritant in the dilutions employed, and hence stimulates the circulation of blood through adjacent tissues.

(7) It causes but little pain.

(8) It induces the prompt appearance of firm, healthy granulations and the early separation of sloughs.

(9) It does not stain nor otherwise alter the appearance of tissues other than those which are necrotic.

The chief objection to the employment of the drug is that it is a dirty preparation, and renders both dressing and bed linen unsightly.[1]

Certain precautions in its employment are necessary. Solutions must be prepared at least once daily. Water above a temperature of 110° F. should not be used in preparing the solution, nor should the solution be heated above this point. When hydrogen peroxide has been employed as a cleansing fluid this should be washed off with saline or an excess of potassium permanganate before the dressing is applied.

A solution of two or three per cent is applied in dressing patients who are under an anæsthetic, while for patients who are conscious a solution of one half to one per cent is less irritating. The burning sensation, of which some patients complain, is of very short duration, passing off in five minutes, or even less.

In applying the dressing it is important that a sufficiently large dressing be employed. The author uses sufficient loosely shaken-out gauze soaked in the solution to fill in all cavities and crevices

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[1] Instruments, gloves, bowls and hands which have been discoloured can be readily cleansed by means of small quantities of acidified hydrogen peroxide solution.

in the wound. Through this gauze numerous small rubber tubes protrude. Several thicknesses of gauze cover the surface of the wound. Over this is placed one or two thicknesses of cotton wool also soaked in the solution. The whole is then covered with jaconet or with dry cotton wool. Owing to the absence of maceration an impermeable covering may be employed with advantage in many cases.

Dressing should be changed more or less frequently, depending upon the nature of the case. It is unusual for it to be necessary to change the dressing next to the wound more frequently than once in twenty-four hours.

As a rule, it has been found useful to repeat the permanganate dressing for four or five days, although not infrequently, even in cases in which gross gangrene has been present, two dressings suffice to arrest infection and prepare the wound for treatment by means of some bland dressing such as saline or boric acid.

In the treatment of those parts of the body which can be advantageously treated by baths, potassium permanganate in dilutions of 1 to 200 to 1 to 500 is used.

It is difficult to analyse results of treatment upon the statistical basis, since the wounds vary so greatly in extent and importance of tissue injured and in the length of time which intervenes between the reception of injury and their coming under observation at the clearing station. Variations, also, in the nature, size, and velocity of the projectile and in the amount of contamination influence profoundly the cause of reaction and repair in the wound.

The difficulties of keeping accurate records in a clearing station —more particularly during those periods of activity when most cases are seen—increase the difficulties of analysis.

Several hundred cases have come under the author's observation; of these a large percentage, at the time of admission, showed evidence of aerogenes infection. Of these some forty have had massive or rapidly extending gas gangrene. Three cases were moribund as a result of aerogenes infection, and although efforts were made in all three cases to control the disease and stimulate the heart all died within four hours of admission.

Conservative interference, in so far as this refers to amputation, has been practised in all cases, and in but one case—a penetrating wound of the chest—has a patient been lost as the result of aerogenes infection and toxæmia. Many patients have, of course, died as a result of the severity of the wounds, and, unfortunately, a certain number of those cases which are evacuated are known to

have ultimately succumbed to chronic intoxication, intravascular thrombosis, etc.; but in so far as gas gangrene itself has been concerned our results have been very gratifying. Nor have we any undue proportion of other wound complications. The great majority of cases have been evacuated with wounds free from slough, with granulation progressing favourably and with the patients constitutionally in relatively good condition.

In a very large group of severe lacerated wounds of the buttock, thigh and arm, seen early and before aerogenes infection had made itself manifest, our results have been uniformly good. In a certain number of cases of this nature other preparations, more particularly eusol, have been employed. The results in such cases have been less satisfactory, and we have returned to potassium permanganate as the dressing of choice.

SUMMARY.

Unless adequate operative and mechanical treatment of wounds infected with the *B. aerogenes capsulatus* is carried out, no antiseptic employed as a dressing will be of value.

Potassium permanganate should be employed in the dressing of all wounds in which *B. aerogenes* infection has commenced, as evidenced by the characteristic odour, the anchovy-sauce-like discharge, gas bubbles, emphysema or tympanites of the tissues, and the pinkish, dull alteration in the appearance of the muscles. In addition, all the more extensively lacerated wounds, especially if accompanied by bone comminution or injury to important vessels, are best treated with potassium permanganate dressings.

In the author's hands potassium permanganate solutions in dilutions of from three to one half per cent have proved more efficacious in the prophylaxis and treatment of wound infection by the aerogenes group of anaerobes than other preparations.

Clinical and other Notes.

FILTERS AND FILTRATION.

By Major P. J. MARETT.
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The term "overcrowding" has always been used with reference to the occupation of buildings, and has been synonymous with air vitiation. Where camps are concerned, unsatisfactory disposal of refuse gives rise to overcrowding or ground vitiation. Till this campaign it was an axiom that the longer a camp site was occupied the more unhealthy it became, the reason for this being solely due to the methods of refuse disposal. The old general rule "to burn what you can and bury what you cannot burn" has probably gone, to be replaced by "burn all solids and filter all fluids." Refuse disposal, whether reckoned as vitiated air, which requires removal by dilution, or other waste products that need to be dealt with, can all be brought down to the elemental physical conditions of gases, fluids and solids.

In camps, air vitiation is dealt with by ordinary routine methods, and will not be further referred to. The disposal of solid refuse by incineration is well recognized; so many papers have been published on the art of incineration that it is unnecessary to here refer to incinerators except to recognize their full value. The subject under review, therefore, is the disposal of fluid refuse, which is readily grouped under the following headings:—

(A) Grease water from cook-houses.
(B) Ablution water, from ablution and bath-houses.
(C) Urine from latrines.
(D) Storm water.

Filtration is essential and not "trapping."

Two forms of filter are here described, their exteriors only varying with ground sites.

Plan I, which is headed "Cook-house drainage," is so called because the complete outfit for filtration only is shown. This plan is divisible into three parts:—

Part A consists of a sloped cement floor with gully channel leading into a drain. For accessory it has a metal funnel which fits easily into the drain, and is for coarse filtration. This funnel takes the place of the old-time grease trap, and is divided into funnel and collar, at the junction of which is a perforated metal strainer. The funnel is filled with straw.

Part B consists of three concrete chambers, the first chamber acts as follows: The baffle is placed as near the second chamber as possible,

and in the latest types of installation reaches the bottom of the pit where it is perforated with holes to a height of six inches from the bottom. The action which occurs in this pit is, therefore, that solids heavier than water fall to the bottom, whilst solids lighter than water are kept back by the baffle plate. The lighter solids form a scum and assist in filtration by mechanical means. From Pit 1 the purified water passes into Pit 2, a coarse filter which is downward in its action; the substance used for filtration being fine road metalling or when available washed gravel. Having reached the bottom of the downward filter, water then passes into Pit 3, which is filled with ashes or fine coke. Here filtration is upwards, and from Pit 3 the effluent passes on to Part C.

Part C consists of a pit 8 feet deep and 6 feet square connected with Part B by a 4-inch drain pipe which is led down to two-thirds of the depth of the pit. The pit is filled with burnt tins for 6 feet 6 inches, the upper 1 foot 6 inches being filled with road metalling. An overflow channel 4 inches below the inlet pipe level is provided. This channel is let in for the purpose of allowing the overflow of filtered water from the pit in cases where absorption would cease. The reason for running the inlet pipe down to 2 inches from the bottom allows of ample further upward filtration when excess can be run over the ground surface. This outlet pipe is not shown in the plan. In the case where buildings are situated on a slope the filters should invariably be placed on the lower side to allow of water running away from the outlet, should this be necessary. Where no slope exists and there is no possibility of surface irrigation, drain pipes are led down to within 6 inches of the bottom of the pit, so that when necessary the pit can be pumped out and water removed in barrels. It is hoped that the diagram is clear enough not to require further description of detail.

The reason for dividing the plan up into Parts A, B, and C is the following:—

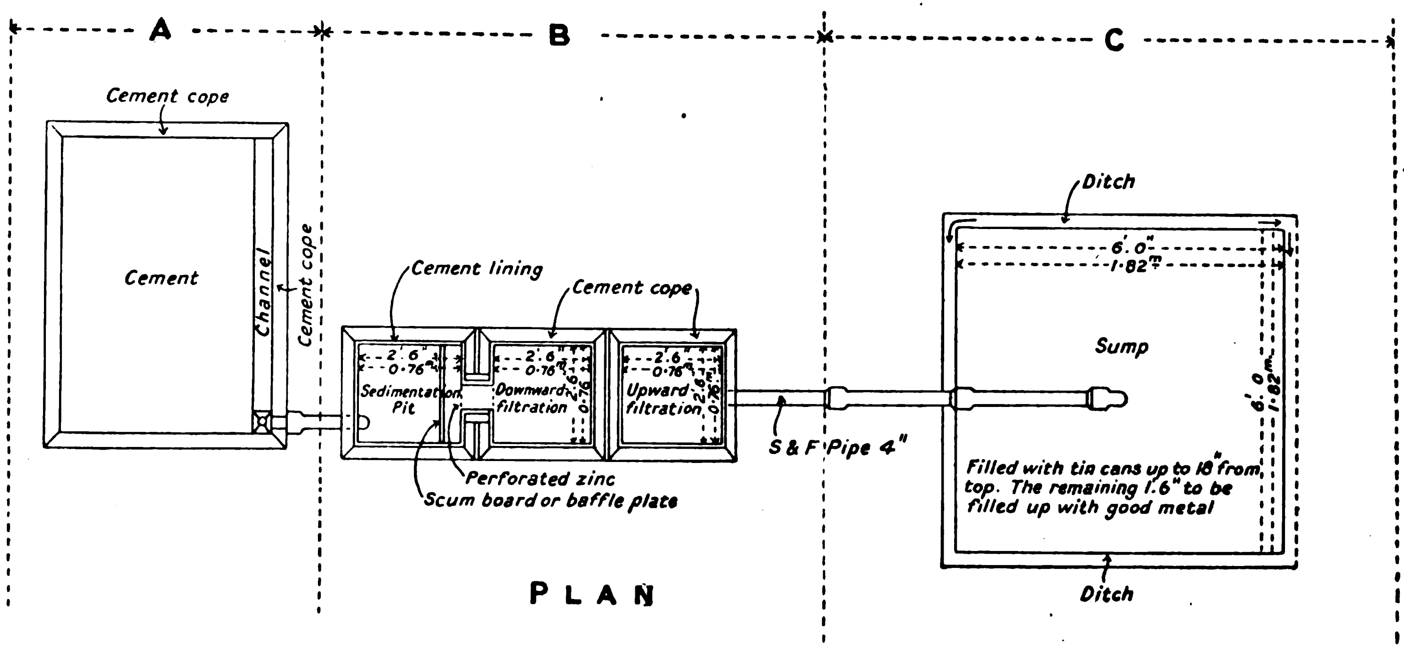
The complete system A, B, C is required for a cook-house, and a further accessory is a lean-to over the concrete slab, which is fitted up with washing bench, plate rack and hooks for holding mugs. The complete system without a lean-to costs about thirty francs to erect.

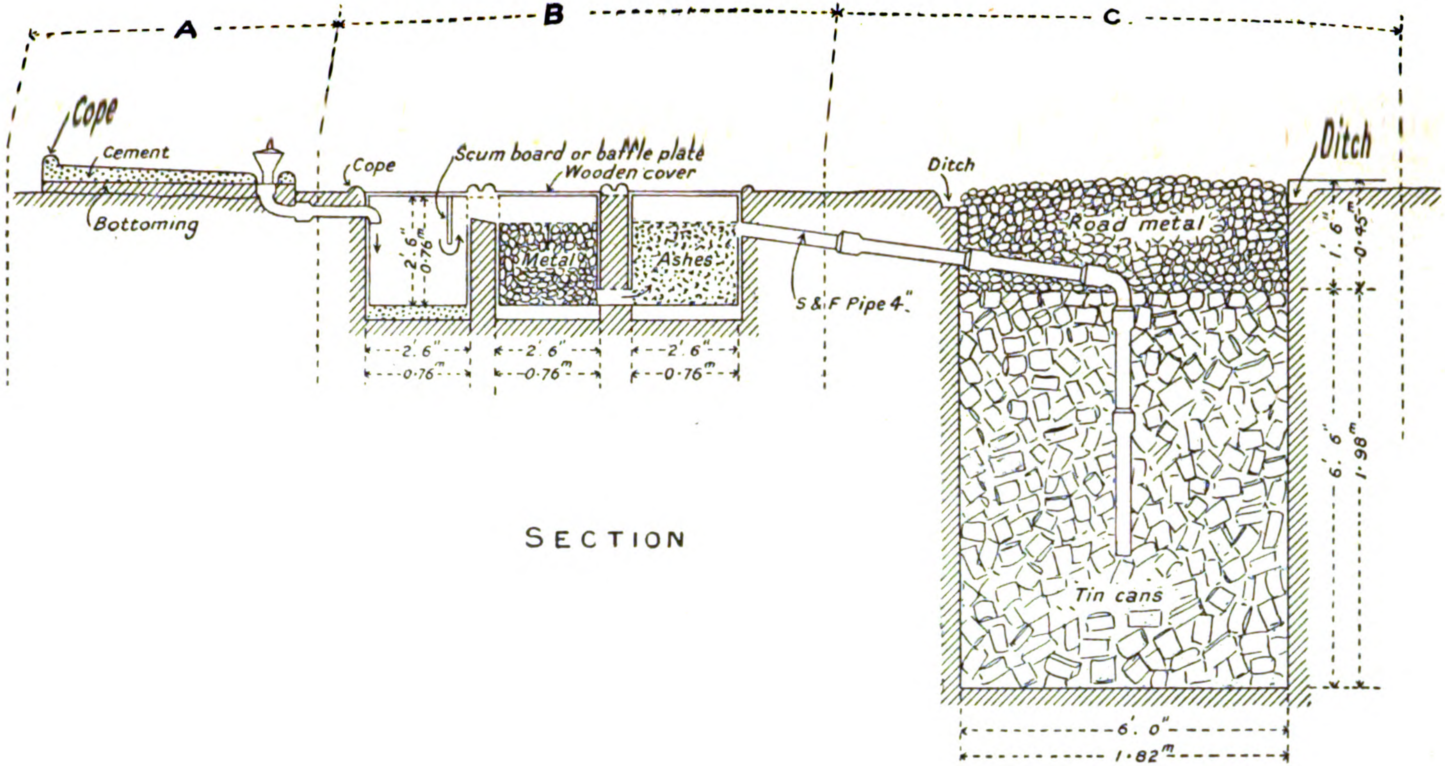
Parts B and C are necessary for ablution and bath-houses, whilst Part C is used for urine from latrines or for rain water. No soakage pit is ever used for both sullage water (including urine) and for rain water. To prevent the entrance of rain water a ditch is dug around the area of the pit, as otherwise there is danger of sediment gaining access and gradually clogging it up.

Plan II shows the necessary plant for sites where owing to a high subsoil water level it is impossible to dispose of water into the ground.

The various parts consist of A, a funnel as previously described, B a cresol drum fitted up with a baffle, and a perforated tin, C, to hold chloride of lime; this tin is placed so as to have its lower margin below

Cookhouse Drainage.



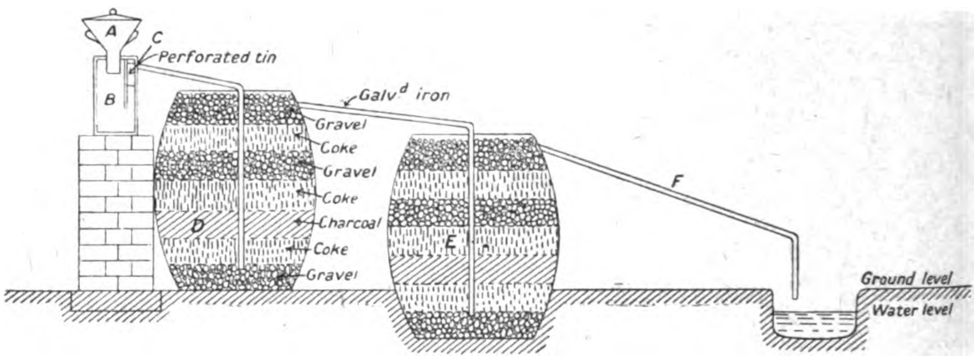

A
B
C
Cope
Cement
Bottoming
Cope
Scum board or baffle plate
Wooden cover
Metal
Ashes
Ditch
Road metal
Ditch
S & F Pipe 4"
Tin cans
2' 6"
0·76m
1' 6"
0·45m
6' 6"
1·98m
6' 0"
1·82m

SECTION

the level of the exit pipe. D is a wooden barrel painted inside and out with crude oil and well caulked; the overflow pipe passes from B to within 6 inches of the bottom of barrel E.

Both barrels are filled with filtering material as indicated in the diagram. F is the overflow pipe which is led off into a stream.

The size of the barrels must be varied according to the amount of water which has to be dealt with. No scum forms in the barrels owing to the use of chloride of lime. This filter in contradistinction to Plan I is a mechanical filter only, whereas that shown in Plan I is a biological as well as a mechanical filter. It may be stated that the above two kinds of filters have been in use for over six months at one base, as the only methods of sullage water disposal.



Scale, half inch = one foot.

The sedimentation pits require cleaning out once a week. The solids removed, consisting for the most part of grease, are disposed of by burning.

In conclusion, it is only fair to state that the whole of the work entailed in the building of these filters has been carried out by Staff-Serjt. T. Eastwood, R.A.M.C., and the non-commissioned officers and men of the sanitary section under my command.

A SIMPLE, RAPID AND ACCURATE METHOD FOR LOCALIZATION OF FOREIGN BODIES SO AS TO INDICATE TO SURGEONS THE POSITION OF THE PATIENTS WHEN SKIAGRAPHED.

By Captain H. E. GAMLEN.
Royal Army Medical Corps.

Lately during the battle periods it has been found impossible to cope with the increased amount of work owing to the difficulty of obtaining plates, and the fact that the routine method of plating incurred

delay. In consequence, it has been decided with few exceptions to screen the cases and where possible to make examinations and report upon the presence and position of foreign bodies, fractures, etc., and forward to the wards at once. By this procedure we have been able to reduce the plating of cases by 40 to 50 per cent., and furnish the surgeons with the diagnosis within a few minutes. The objections to screening and localiz-

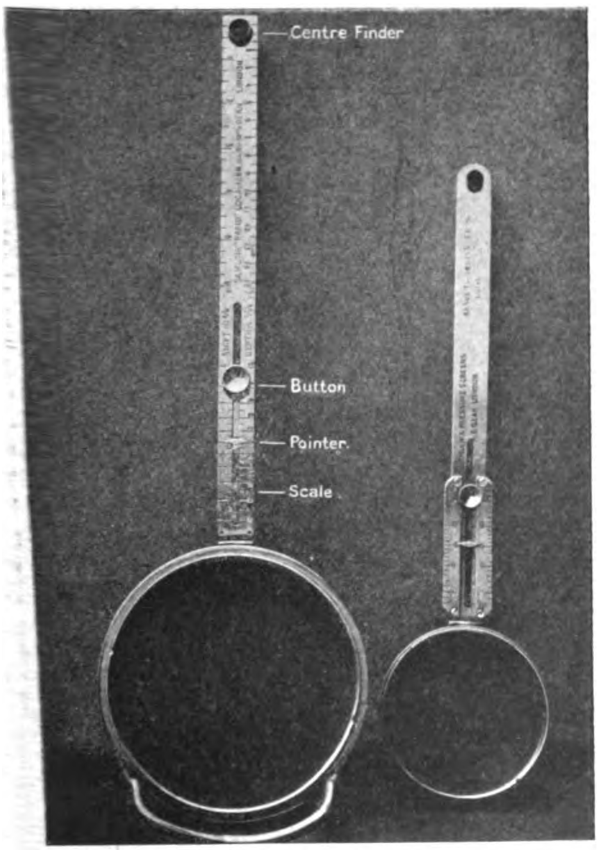


FIG. 1.—Method for localization of foreign bodies.

ing at the same time are several. Firstly, there is the danger to the hands of the operator. It is doubtful whether after working several hours daily the gloves give ample protection, especially if the hands of the operator are already sensitized by previous burning.

Secondly, there are parts of the body, such as the neck, axilla, perineum, etc., where the curvature of the body prevents the ordinary

fluorescent screen from being brought into close apposition with the skin surface. When the depth of the foreign body beneath the screen surface is known, allowances have to be made for this separation, and whilst this is being carried out the patient is apt to move his position and the work has to be gone over again.

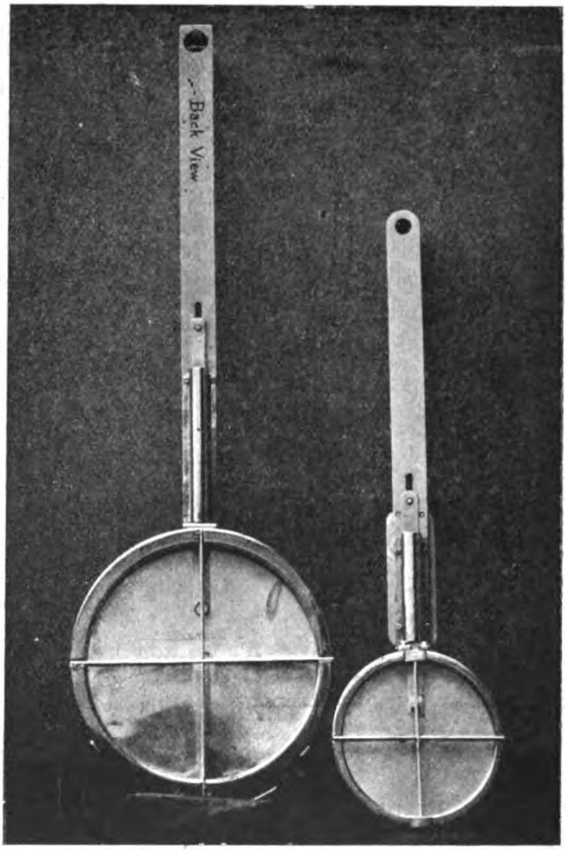


FIG. 2.

Finally, the time spent in localizing and the errors which often creep in owing to one not having the patient during the operation in exactly the same position as during the screen examination. I have been able to overcome as a result of various experiments all these objections.

The instruments I use are localizing pressure screens, two, four and six inches in diameter. The smallest will fit into any part of the body, and the last is large enough for any ordinary screen examination. The

instrument in appearance looks very much like a frying-pan. Each has a long steel flat handle from six to eight inches in length, and the pan portion combines three purposes:—

(*a*) Fluorescent screen.
(*b*) Localizing apparatus.
(*c*) Cross wire marker.

(*a*) The bottom of the pan is made of aluminium, on which rests the fluorescent screen with its protection of glass or celluloid.

(*b*) Beneath the pan are two cross strips at right angles to each other, The one in line with the handle is of aluminium, the other being of thin steel. Beneath the handle is a thin narrow aluminium movable rod, one end of which terminates half way up the handle in a pointer and finger button for movement of the rod. The other terminates in a small lead shot whose normal point is the centre of the cross-wires.

As this rod moves up and down, it records the depth of the foreign body in centimetres, which is scaled on the handle.

At present we have these instruments scaled for a distance of 52 centimetres and a tube shift of 6 and 10 centimetres. We are always able by the use of air cushions of varying thickness to work at a distance of 52 centimetres from the tubes.

The method of procedure is as follows:—

First expose the part and search for the foreign body, and when found place the limb in the best position for operation purposes. Then cut down the beam of X-ray light until it just covers the screen. The lead shot which is at the normal zero position is made to just overlap some part of the foreign body, and the screen is gently pressed upon the part under examination. One of the diaphragms is moved so as to allow only a narrow slit of light to pass through and then the tube is shifted to its second position. The shot is now made to follow the foreign body until it overlaps again, the traverse of which is indicated on the scale of the handle. On turning up the light, the depth is read off as so many centimetres or inches, and the impression of the rods is left on the skin of the patient in the form of a cross which is at once made permanent by tracing it with moistened copying pencil or nitrate of silver. The round hole with raised edges in the far end of the handle is also used for localizing the direction of the pencil of light in the direct line of the foreign body. The handle is pushed beneath the patient, and when the hole is in alignment with the foreign body it is gently pressed upon the skin, which when examined is found to show the shape of the circle.

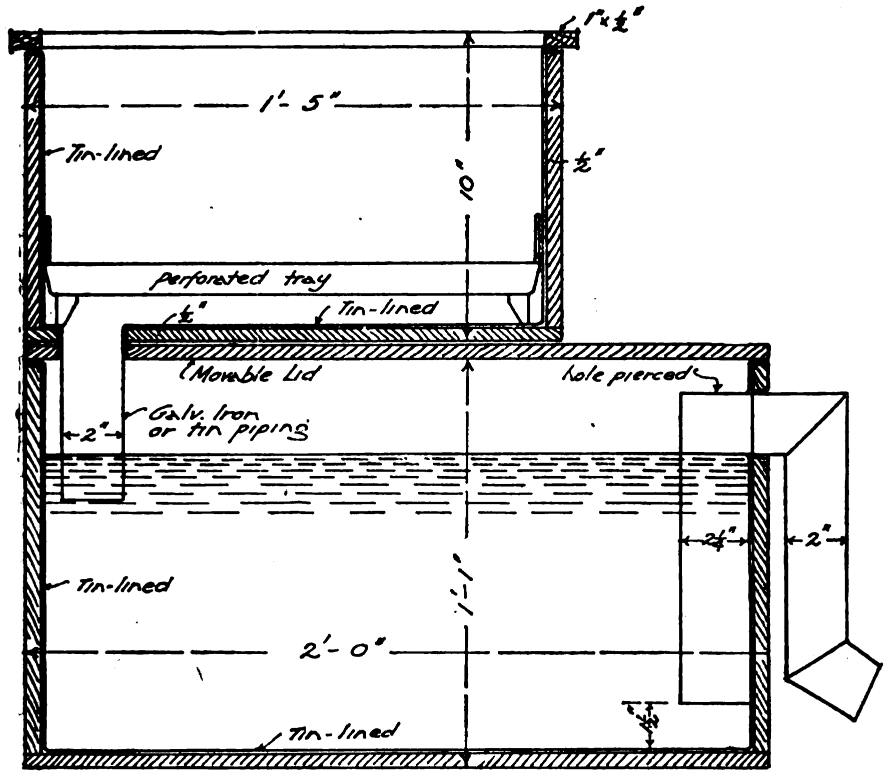
Finally this circle is made permanent by copying pencil. In this way, if we think it best to plate the part, we have at hand the best data for doing so, and it is quite easy to overlap the cross wires with those of the plate holder.

These instruments were made by A. E. Dean, London.

A SIMPLE IMPROVISED GREASE TRAP.

By Lieutenant-Colonel JAS. HARDIE NEAL
New Zealand Medical Corps.
Officer Commanding 3rd New Zealand Field Ambulance.

During the last few months we have been making use of a grease trap designed by Serjt. E. M. Dillon of our Ambulance, who has charge of the sanitary work.



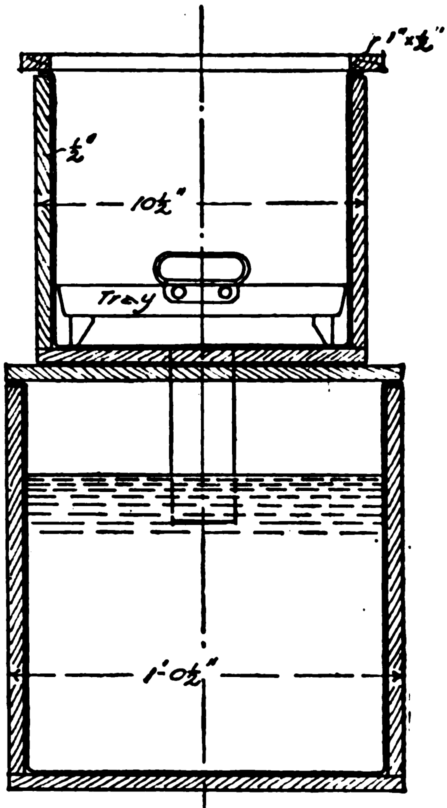
LONGITUDINAL SECTION

It acts on the principle that in hot greasy water the fat floats to the surface, the underlying water in this device escapes from the bottom of the trap by a double angle pipe. This pipe is pierced at the top to prevent syphonage. The accompanying plan will show the construction.

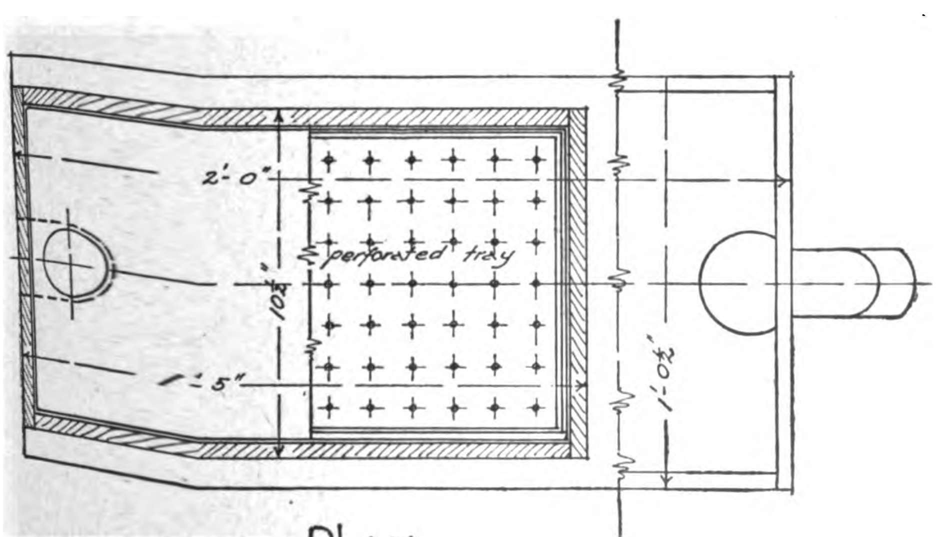
We have found this grease trap very effective. It is wholly improvised from empty ration boxes and biscuit tins.

I have to thank Capt. D. J. Gibbs, of the New Zealand Engineers C.R.E., Franks' Force, for his kindness in having the plans drawn.

A specimen of the trap can be seen at the Sanitary Exhibition of the Second Army in France.



CROSS SECTION



PLAN

Scale, three inches = one foot.

A CASE OF OBLIQUE HEMIANOPIA FROM WOUND OF OPTIC CHIASMA.

By Colonel PURVES STEWART, C.B., M.D., F.R.C.P., A.M.S.
Consulting Physician to H.M. Forces.

AND

Captain A. D. GRIFFITH, B.S., F.R.C.S.
Royal Army Medical Corps (T.).
Specialist in Ophthalmology.

The patient, aged 24, was wounded on January 5, 1916, and came under observation a week later. He had multiple shrapnel wounds of both upper limbs and of the right lower limb. In addition, one metallic fragment had entered through the right upper eyelid, destroying the right eye and lodging within the cranium, where radiography showed it to be about $\frac{1}{2}$ inch above and $\frac{1}{4}$ inch in front of the upper limit of the sella turcica. It had crossed the mesial plane and was lying $\frac{1}{2}$ inch to the left of the middle line (see figs. 1 and 2).

When hit, he immediately became unconscious and had a subsequent period of amnesia which lasted for several weeks, throughout the attack of septic meningitis which followed. Two days after his injury, on board the hospital ship, it was noted that he was completely blind and that the pupil of the uninjured left eye was widely dilated and insensitive to light.

The signs of severe meningitis rapidly increased, with headache, delirium, pyrexia and head-retraction. For the first ten days the patient seemed moribund, and minute observations on his eyes seemed impossible. He then began to improve, and was more carefully examined on January 17, i.e., twelve days after the injury. On this day the temperature, which since admission to hospital had been swinging between 100·8° and 103·4° F., was 101·8° F. The pulse, which had varied from 88 to 100, was 96. The patient was now able to reply intelligently to questions, although still at times mildly delirious. He complained of headache and cervical rigidity. The right eyeball was completely disorganized and suppurating. The left eye had no perception of light, and its pupil was widely dilated and insensitive. The left optic disk and fundus were normal. In particular, there was no pallor of the disk and no suspicion of optic neuritis. The cranial nerves were otherwise normal. There was no sensory or motor paralysis of the face, trunk or limbs. The knee-jerks and ankle-jerks were normal. The plantar reflexes were of the normal flexor type. Kernig's sign was well marked. The cerebrospinal fluid was opaque and milky ; on standing, it showed a thick deposit of pus. The meningitis gradually subsided during the next six weeks under treatment by urotropine internally, together with lumbar puncture on alternate days, the cerebrospinal fluid becoming normal.

On January 29 the right eye was excised. The globe was found to be full of blood-clot. There was no obvious suppuration within the orbit.

FIG. 1.

FIG. 2.

To illustrate "A Case of Oblique Hemianopia from Wound of Optic Chiasma." By Colonel PURVES STEWART, C.B., M.D., F.R.C.P., A.M.S., and Captain A. D. GRIFFITH, B.S., F.R.C.S., R.A.M.C.(T.).

On February 4, i.e., a month after the injury, it was observed that some vision had returned in the left eye, in the nasal half of the field, so that the patient could distinguish hand-movements close to the eye.

On February 18, when the meningitic symptoms had subsided, and the cerebrospinal fluid had become almost clear, the hemianopia of the left field was confirmed.

From February 24, the temperature remained steadily normal. On March 1 the lumbar punctures were discontinued.

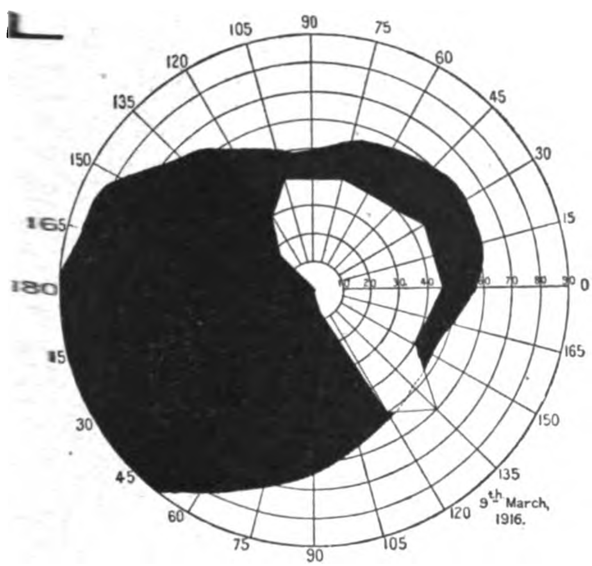


FIG. 3.

On March 9 a more careful examination of the left eye was made. The optic disk was now diffusely pale and atrophic. The left pupil was widely dilated, and showed a typical hemiopic reaction, i.e., when a pencil of light was thrown on the sensitive temporal half of the retina, the pupil contracted, whereas a similar pencil of light thrown on to the blind nasal half of the retina produced no reaction. The boundary between the blind and the seeing halves of the visual field was not vertical but oblique, running through the 120° meridian (see fig. 3).

On March 13, this obliquity of the hemianopic boundary was confirmed and a slight gain of vision was detected in the blind half of the field, close to the fixation point (see fig. 4). On this day the vision was $\frac{1}{60}$.

By March 21 the vision had further improved, to $\frac{5}{60}$, and the visual field had also extended slightly more into the blind area, both horizontally

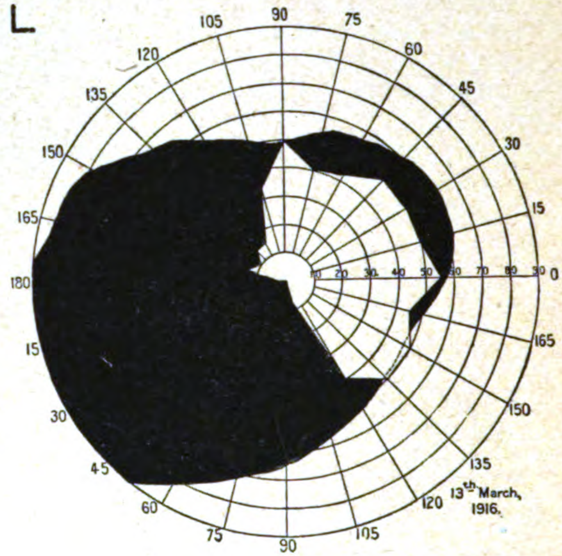


FIG. 4.

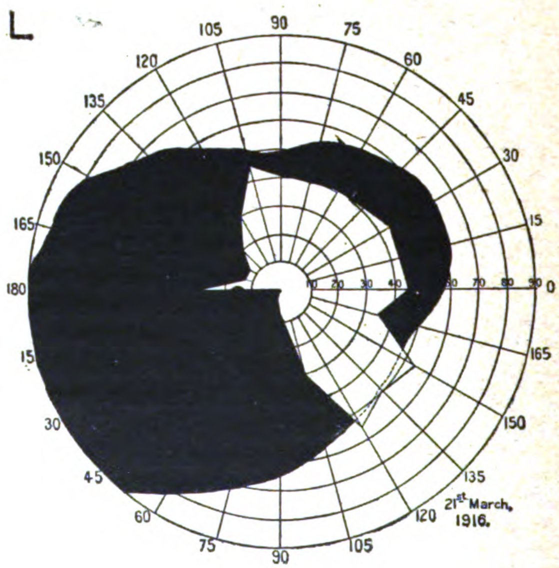


FIG. 5.

outwards and also, in the 105° meridian, downwards and inwards (see fig. 5), where the field had widened from the 8 circle to the 30 circle. Moreover, there was now a little vision directly downwards, and even a trace in the 75° meridian, downwards and outwards.

On March 23, the pupillary reaction was no longer typically hemiopic, for now the pupil contracted to light thrown in from either side, although more briskly to light from the seeing half of the visual field.

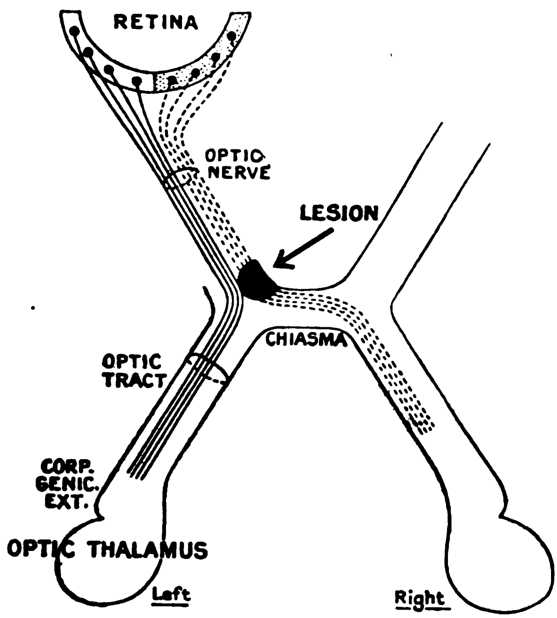


Fig. 6.

Lesions of the visual path have been by no means uncommon during the present War. We have ourselves seen numerous examples of cortical and of sub-cortical lesions and of lesions of the optic radiations. Such cases present features of interest which have been studied by many observers. Lesions of the optic tract, which are commonly associated with signs of pyramidal affection from injury to the adjacent crus cerebri, are far less common. An excellent example, however, has been published by Marie and Chatelin (*Revue neurologique*, 1915, p. 1232). Lesions of the chiasma itself, without implication of the long tracts of the brain-stem, are still rarer, and this must be our excuse for recording a single case.

In the foregoing case, the presence of an apparent left-sided hemianopia seemed at first to indicate a simple lesion of the right optic tract, somewhere behind the chiasma. The occurrence of the hemiopic

pupillary reaction further limited the probable position of the lesion to a spot somewhere below the primary reflex visual centre in the right external geniculate body. Further observations, however, showed that it was not so simple as this.

Let us recall, for a moment, some points in the anatomy of the visual path. The fibres from each optic nerve run backwards to the optic chiasma. Here a partial decussation occurs (see fig. 6), so that the fibres from the right halves of both retinæ, i.e., from the left halves of both visual fields, after traversing the chiasma, emerge behind it to form the right optic tract. Similarly with the fibres from the left halves of the retinæ, which enter the left optic tract. The macular or central visual fibres from the macula lutea of each eye are distributed in both optic tracts. As the chiasma is approached, the fibres from the nasal halves of the retinæ (temporal halves of the fields) tend to become ventral in position, while those from the temporal halves tend to become dorsal. The macular bundle occupies a central position. The optic tract, emerging from the chiasma behind, contains visual fibres from the whole contra-lateral half of both visual fields, including the central fixation-point of each eye. It winds backwards, around the outer side of the crus cerebri, to the primary optic centre in the external geniculate body and anterior corpus quadrigeminum. The farther backward course of the visual fibres to the cortical half-vision centre in the calcarine cortex does not concern us here.

In our case, the apparent left-sided hemianopia, together with the hemiopic pupillary reaction, seemed, at first sight, to point to an ordinary straightforward lesion of the right optic tract. More careful study, however, showed that this was not the case. Firstly, the boundary between the blind and the seeing area of the visual field is not vertical, as in an ordinary tract lesion, but oblique. That is to say, both lateral halves of the visual field are affected, including nearly the whole of the left field and a small sector of the right. The incompleteness of the affection of the left field is further evidenced by the fact that there is also a small area of recovery extending outwards from the fixation-point.

Fig. 6 is a diagram indicating the position of the lesion in this case. The lesion affects mainly the fibres destined for the *right* optic tract. Some of them, however, have escaped, viz., those corresponding to the upper and mesial sector of the blind field, also a smaller number corresponding to the area just above the horizontal plane, directly outwards from the fixation-point. These latter fibres, from their central position in nerve and chiasma, would be well protected from injury. In addition, a number of fibres destined for the *left* optic tract are also implicated, viz., those corresponding to the lower and mesial sector of the right half of the visual field.

X-RAY REPORTS.

By G. E. RICHARDS, M.B.
Radiologist.
Royal Army Medical Corps.

After experimenting with various forms of reports and methods of reporting and recording X-ray findings to the surgeons in charge of cases both in civil life and during the present War, the following has been adopted, and is now in use in this hospital. It may be recommended as providing the surgeon immediately with a graphic representation of the condition reported upon, particularly in the case of fractures; is devoid of many of the disadvantages of the ordinary contact print, and saves him and the X-ray operator the necessity of a visit to the department to inspect plates just in the middle of a busy morning's work. It also provides a record of the injury, becomes incorporated as a part of the case history, and follows the patient wherever he goes.

The advantages claimed are: (1) Clearness of definition—the print having all the detail of the original plate, and being free from the heavy shadows of the plate, is often more easily interpreted by one not expert in this work. (2) The image is direct, not reversed, as is the case in a contact print (the plate being placed in the apparatus, film side out) (3) Bones and soft tissues are shown as the darker shadows, thus more nearly conforming to the ordinary conception of these structures.

As soon as the plate is out of the fixing solution, and washed slightly, a reduction-print is made on bromide paper to any size desired; in our work we use a standard lantern-slide, size 3¼ inches square. The print, having been developed and fixed, is washed immediately, dried in spirit, and the report with print attached is sent out the same afternoon. If time permits, prints may be finished on a ferrotype plate, and will then be ready by next morning at latest.

The method has been found quite satisfactory, not cumbersome in operation, and has been favourably reported upon by the surgeons on the staff of this hospital. I therefore feel justified in putting forward the suggestion for more general use, both in military and civil work, as a convenient means of keeping a permanent record of cases in small space and easily available form.

The process of reduction need not involve an elaborate apparatus. All that is required is a light-proof box, at one end of which is fitted a lens and shutter—easily improvised from any ordinary second-hand camera—the other end being provided with a plate-holder capable of adjustment to varying focal distances. Mounted in front of the lens is a light-proof tunnel (it does not require to be absolutely light-proof) sloping up to a frame the size of the X-ray plate. To reduce from an 8-inch by 10-inch plate to a 3½-inch, the length of the tunnel will be about 18 inches, depending upon the focal length of the particular lens being

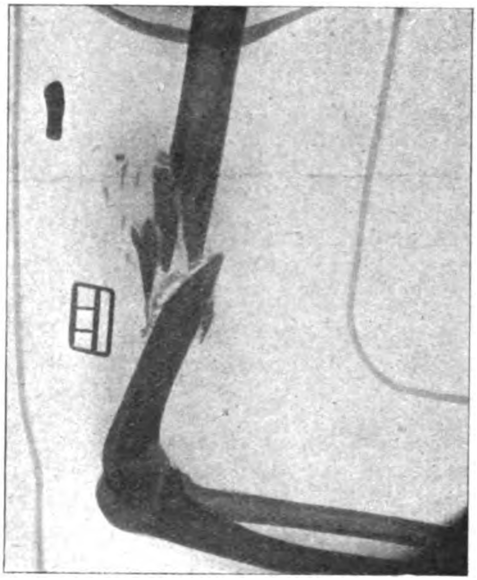


FIG. 1.—Comminuted fracture of humerus in the middle third. Foreign body lying just under the skin at external aspect of arm.

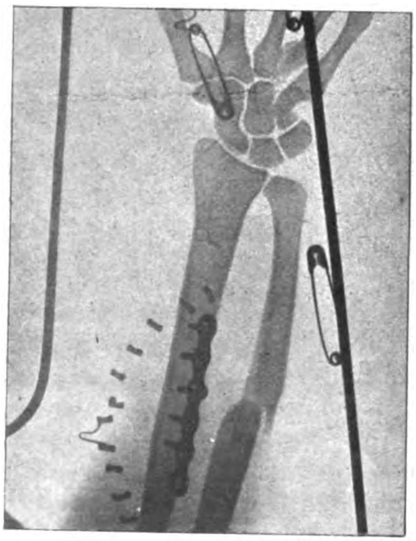


FIG. 2.—Fracture both bones of forearm. Radius plated. Plate and bones in good position. Skin wound closed with Michel clips.

used. This apparatus is, of course, a fixed-focus one, and once adjusted needs no further attention.

A Simple Method of Localization of Foreign Bodies.

So far as I am aware, the following method of localizing foreign bodies has not been published, and is so simple and practical that it deserves wider recognition.

Perhaps no subject has received more thought by radiologists during the present War than has the matter of simplifying localization. Any method, to be acceptable, must in the first instance be accurate, rapid, and capable of wide application. The method here described is most useful in the extremities, but has been used successfully many times, also in such parts as the shoulder and hip-joint regions, and occasionally in the trunk. For very accurate measurements recourse is always had to some of the well-known methods, such as Mackenzie-Davidson's, etc.

Apparatus.—The usual table, with tube underneath, permitting movements laterally and in the long axis of the table. A fluorescent screen. A piece of flat wood 12 inches long by ½ inch wide and ¼ inch thick, in one end of which is embedded a flat piece of metal the diameter of a shrapnel bullet, i.e., ½ inch roughly.

The Method.—The patient is placed upon the table in the recumbent position. Suppose the preliminary screen examination shows a foreign body to be lodged in the thigh somewhere in front of the femur. Place the flat stick with its metal piece under the thigh, screen above, and move the stick about until the shadows of the metal and the foreign body are superimposed. Mark the skin on the posterior surface of the thigh at the point where the metal rests. Proceed as before, but with the stick on the anterior surface of the thigh, until the two shadows are again superimposed. Mark the skin at this point also, and join these two positions by a line running around the limb. A probe passed directly through the limb from the anterior to the posterior marks would pass through the foreign body. We therefore have one plane.

Now, lay the stick upon the table so that both shadows appear on the screen, and shift the tube backwards and forwards under the table. The two shadows are now seen to move—but unequally. Gradually bring the stick with its metal piece towards the anterior surface of the thigh, keeping the tube under the table constantly shifting. As the metal approaches the horizontal plane in which the foreign body lies, it will be found that the two shadows move less and less unequally until a point is reached where they move equally and together. The foreign body must, therefore, lie in this plane, for if this point be exceeded by moving the metal nearer to the anterior surface of the limb, the two shadows again move unequally. For the most accurate use of this method, one should repeat the procedure just described on both the inner and outer aspects of the limb, making marks on each side upon the line joining the first two

positions, at the level at which the two shadows are found to move in unison. The foreign body will be found at the point of intersection of the two planes.

It may be said that one of the chief virtues of this method is speed, which is important when a large amount of work is in hand. Patients are brought to the X-ray room, the foreign bodies localized, and they are then passed immediately to the operating-room adjoining for operation.

ON TYPHUS FEVER.[1]

By Major ALEXANDER G. R. FOULERTON, F.R.C.S.
Royal Army Medical Corps (Territorial Force).

The value of statistics as to case-mortality in earlier epidemics of typhus fever was very doubtful. In the past there had been confusion in the diagnosis of typhus, typhoid, and relapsing fevers, and epidemic cerebrospinal meningitis. During the War now in progress, the case-mortality of typhus fever amongst the Serbian army in the field had been fifty per cent, or about the same as the recorded case-mortality amongst French troops in the Crimean War. It had been stated that the case-mortality amongst Serbian prisoners of war, in Austrian and German hands, had been twenty-five per cent in uncomplicated cases, and forty per cent in an apparently large group of cases in which diphtheria and typhus fever had been intercurrent. The Austro-German armies had had a considerable experience of typhus fever during the War, and a noticeable feature had been the frequent association, in the same patient, of typhus fever with some other infective disease—influenza, diphtheria, dysentery, malaria, and typhoid and relapsing fevers. This varied association of infection was doubtless a result of cross-infection in military hospitals by the agency of typhus-infected lice. Similar cross-infection had occurred in one instance, at any rate, in connexion with another louse-carried disease, relapsing fever. The relative frequency of double infection was, in part, an explanation of the variety of parasites described as having been obtained by bacteriological examination of the blood from cases of typhus fever. It was difficult to understand, in view of the results of exact experimental work, and with knowledge of experience that had been gained during the War, how the importance of insect parasites in the transmission of the unknown virus of typhus fever could be questioned. The spirochæte of relapsing fever was certainly carried by lice, by ticks, and possibly by other insect parasites; it was equally certain that the louse was a carrier of the virus of typhus fever, and it

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[1] Contributed to a Discussion on "Recent Researches into the Ætiology of Typhus Fever," in the Section of Epidemiology and State Medicine of the Royal Society of Medicine, on Friday, May 25, 1917.

was, so far as our knowledge at the present time went, probably the only common carrier. It was impossible to exclude the possibility of other means for the transmission of typhus infection; but the modern teaching was that a patient with typhus fever who had been freed from lice was no longer a cause of danger to others. Nicolle had related recently some details of a criminal experiment as to the transmission of typhus fever by the louse that had come within his knowledge. A warder in a colonial prison had maliciously transferred lice from a prisoner with typhus fever to two healthy prisoners, both of whom became infected. Professor Jürgens had referred, at a joint congress of Austro-German military medical officers which was held at Warsaw in May, 1916, to another experiment carried out in Germany. Twenty healthy men were confined closely with twenty patients suffering from typhus fever who had been freed from lice; there was not any transmission of infection to the healthy. Similar evidence was afforded by the experience of the Russian prisoners of war camps in Germany; when the prisoners had been freed from lice, the previous heavy prevalence of typhus fever disappeared. Again, preventive measures which were directed exclusively to the freeing of certain units from lice had proved completely effective for the prevention of a danger, that threatened at one time, of the introduction of typhus infection amongst allied troops on the Front in France. The seasonal prevalence of typhus fever correlated with the seasonal prevalence of lousiness, as the latter had occurred amongst the troops in the field. In the colder months of the year the men put on more clothing, were generally less inclined to wash themselves thoroughly, and slept closely together in billets. In the summer months, less clothing was worn, personal washing was carried out more thoroughly, and the men were bivouaced out as much as was possible, and lousiness was markedly diminished amongst the troops during the summer months. Doubtless seasonal conditions influenced the prevalence of lousiness amongst civilian populations under somewhat similar conditions, so that in temperate climates typhus fever was essentially a winter disease. The association of typhus fever with times of privation and famine was probably due to widely spread neglect of personal cleanliness, and consequent increased prevalence of lousiness. So far as could be ascertained it appeared that relapsing fever also was most prevalent under the colder climatic conditions. It had been suggested that the fact that a skin eruption occurred rarely amongst monkeys and guinea-pigs that had been infected with supposed typhus virus was evidence that typhus virus had not been conveyed. This line of argument was not of any account; a skin eruption was not by any means a necessary concomitant of typhus infection in man. For the rest, Nicolle and Blaizot had succeeded in keeping two strains of typhus virus alive for more than two years, by passage through the guinea-pig to monkeys, and again through monkeys to the guinea-pig. At the end of two years, the

blood of an infected guinea-pig injected into a healthy guinea-pig produced symptoms exactly similar to those caused either by the injection of the blood of a patient with typhus fever, or by the injection of an emulsion made with lice taken from a case of typhus fever. The same writers had proved that the virus of typhus fever was retained in most of the tissues of an artificially infected guinea-pig after all traces of blood had been removed by prolonged irrigation of the blood-vessels with saline solution. The parasite causing typhus fever had not yet been identified positively. But two suggested parasites had to be considered—one of them seriously. They were the Plotz-Olitsky-Baehr bacillus and *Rickettsia prowazeki*, described by Toepfer and Rocha-Lima. It was not apparent that the Plotz-Olitsky-Baehr bacillus had any causative relationship to typhus infection. The bacillus, when injected into the guinea-pig, did not cause the sequence of symptoms produced by the injection of blood from a case of typhus fever; nor did the injection protect the guinea-pig against a subsequent inoculation with actively virulent blood from a case of typhus fever. Behind all that, it was impossible to accept a strictly anaerobic parasite, such as the Plotz-Olitsky-Baehr bacillus, as the cause of a disease of the nature of typhus fever, in which a continuing blood infection was an obvious feature. On the other hand, there appeared to be a high degree of probability that the organism, described under the name of *R. prowazcki*, which had been identified by Toepfer and Rocha-Lima in the cells of the intestinal epithelium of lice taken from cases of typhus fever, represented a phase in the development of the veritable parasite. Stampell had seen, in the intestinal epithelium of typhus-infected lice, small brownish bodies which might be identical with Rickettsia of Rocha-Lima, and which were comparable closely with the organisms found in infected lice by Ricketts and Wilder, and by Prowazek. The "coccobacillus" which Sergent, Foley and Vialette had identified in stained films of blood from cases of typhus fever, and also in films made with the body-juice of lice from cases of typhus fever, but which apparently they had not succeeded in growing on artificial culture media, possibly came within the same category. The evidence as to the causative relationship of the lice bodies to typhus infection was substantial. Somewhat similar bodies had been described as occurring occasionally in the intestinal content of normal lice, but the like had never been found within the intestinal epithelial cells, except in lice taken from cases of typhus fever. According to Rocha-Lima, the parasite appeared in the intestinal epithelium of artificially hatched lice that had been fed on a case of typhus fever on the fourth or fifth day after the infected meal, but only in a small proportion of the number of lice that had been exposed to infection. On the fifth or sixth day after feeding, about fifty per cent of the lice showed the alleged parasite. By the eighth or ninth day the proportion of the number of lice showing the parasite to the number of those that were free from it was about the

same as that obtaining amongst lice taken freshly from cases of typhus fever. Inoculation of the guinea-pig with an emulsion made from the bodies of normal lice was without any obvious effect. Inoculation with an emulsion of the bodies of lice taken from cases of typhus fever, and containing the alleged parasite, was followed by symptoms identical with those produced by the injection of virulent typhus blood, and the animal was protected afterwards against the effects of injection with blood from a case of typhus fever. If Rickettsia represented a phase in the evolution of the virus of typhus fever, it was probable that the infecting parasite was a protozoon. What was known as to the transmission of the typhus virus accorded with what was known as to the transmission of certain protozoal infections from man to man through a necessary intermediate insect host. A comparison of the methods for the transmission respectively of the spirochæte of relapsing fever and the unknown virus of typhus fever was of interest. In relapsing fever the transmission of the spirochæte was direct, the louse was one of several accidental insect carriers. The spirochæte was present in the fæces of the infected louse, and probably could be transmitted by the bite. The louse after feeding on a patient with relapsing fever could at its next feed infect a healthy man. This was not so with the transmission of typhus virus. According to Nicolle, to whom must be credited most of our knowledge in the matter, the louse cannot transmit the virus until seven days after the infected meal, and does not transmit it after the tenth day. Also the virus is contained in the body juices of the louse and does not occur in the fæces. In other words, the virus of typhus fever after it has attained full activity in man must pass through a phase of evolution in the louse before it can be transmitted to a fresh human case. Nicolle's observations are in accordance with the later observations of Rocha-Lima, just mentioned. Rocha-Lima found that Rickettsia first appeared in the intestinal epithelial cells of the louse on the fourth or fifth day after an infected meal, and apparently reached its complete development on the eighth or ninth day. If Nicolle's observations are valid, then the louse must be regarded as a necessary intermediate host in the transmission, under natural conditions, of the virus from man to man, just as some species of Anopheles is necessary as an intermediate host in the transmission of malarial infection. In the guinea-pig and monkey, on the other hand, direct transmission of the virus by means of infected blood occurred under experimental conditions. The question was of importance when preventive measures against the spread of infection were under consideration. It was obvious that a quarantine of at least twenty-one days was necessary when dealing with an infected unit—allowing from six to ten days for the evolution of virus in the louse, and from six to ten days for incubation of the virus in man—after the last man of the unit had been freed from lice. And even twenty-one days' quarantine from the date of the last case of typhus fever did not cover every

possibility. There was the possibility, suggested by a single positive experimental result, of the transmission of the virus from an infected female louse to the ova. The recorded experience in the German army during the War, however, had been that the risk of transmission of the virus to man through a second generation of infected lice was negligible.

FULMINATING CEREBROSPINAL FEVER: PROGNOSIS AND TREATMENT.

By Captains P. W. MACLAGAN and W. E. COOKE.
Royal Army Medical Corps.

"This is the most malignant form of meningitis. It runs a very acute course and frequently kills the patient in from a few hours to a day."—"Epidemic Cerebrospinal Meningitis," *Sophian.*

"The fatal termination usually occurs within ten to thirty hours after the onset."—"Meningococcus Meningitis," *Heiman and Feldstein.*

"The name fulminating or foudroyant has been applied to those cases which begin with startling suddenness and run a uniformly rapid course, terminating in death in twenty-four to thirty-six hours."—"Cerebrospinal Fever," *Foster and Gaskell.*

"Cerebrospinal meningitis may begin abruptly with unheard-of acuteness during apparently perfect health, and terminate fatally after a course of a few hours. Such is fulminating cerebrospinal fever."—"La Meningite Cerebro-spinale," *Netter and Debre.*

Any form of treatment which can hope to modify favourably the course of this type of cerebrospinal fever is worthy of the most careful consideration. In a recent paper (*British Medical Journal* and *Lancet*, December, 1916), we drew attention to the constant association of hæmorrhagic adrenalitis with the fulminating type of cerebrospinal fever. In this type we pointed out that death was due, not to the severity of the meningitis, but to a sudden withdrawal from the circulation of the internal secretion of the adrenal gland, on account of interference with its secreting cells. This results in loss of tone of the muscle fibre of the blood vessels and failure of the peripheral circulation, with secondary failure of the cardiac muscle.

Within a very few hours of the onset of the disease the patient is frequently pulseless at the wrist, but the heart continues to beat for some considerable time. In spite of this, the peripheral circulation cannot be maintained because of the dilatation of the blood-vessels, the patient becomes intensely cyanosed, and death takes place because of the cessation of the circulation.

In the same paper we suggested that it might be possible to replace artificially the epinephrin in the circulation and so restore the vascular tone, until such time as the adrenals might recover their function, or

until this could be undertaken by other members of the chromaffin system. This might be effected by intravenous or intramuscular injection of adrenalin. Subcutaneous injection is useless because the local vasoconstriction produced prevents absorption.

During the three past months we have had several opportunities of testing this theory in fulminating cases of cerebrospinal fever, and we think that the results are sufficiently striking to merit further trial.

Case 1.—G., admitted January 7, 1917: History of abrupt onset. On admission, unconscious and very restless. Extreme cyanosis; no radial pulse to be felt. Heart sounds irregular. Profuse hæmorrhagic rash. Temperature subnormal. Marked neck stiffness. Kernig's sign present. Tendon and superficial reflexes absent. Incontinence of urine and fæces. Liq. adrenalin, twenty minims, given intravenously, and ten minims continued every four hours. Rectal saline. Lumbar puncture, fifty cubic centimetres turbid fluid containing meningococci. Serum, thirty cubic centimetres intrathecally; thirty cubic centimetres intramuscularly. January 8, 1917: Radial pulse can be felt. Conscious; complains of headache. Lumbar puncture, fifteen cubic centimetres clearer fluid. Serum, 60 cubic centimetres intramuscularly. January 10, 1917: Temperature, 101° F. Headache. Lumbar puncture, thirty cubic centimetres slightly turbid fluid. Serum, thirty cubic centimetres intrathecally; thirty cubic centimetres intramuscularly. January 11, 1917: Pulse good. Adrenalin discontinued. Rash fading. Treatment continued as above. Convalescence slow. Sequelæ: Slight inco-ordination and exaggeration of tendon reflexes. Mental condition good.

Case 2.—W., February 17, 1917: History of abrupt onset with headache, vomiting, and rigor eight hours before admission. On admission, quite conscious. Complains of headache and stiffness of back. Slight neck rigidity and Kernig's sign. Temperature subnormal. Considerable purpuric rash. No radial pulse. Heart sounds weak, fast and irregular. Liq. adrenalin, ten minims every four hours. Lumbar puncture, forty cubic centimetres clear fluid. Serum, thirty cubic centimetres intrathecally; thirty cubic centimetres intramuscularly. February 18, 1917: Condition unchanged. Lumbar puncture, sixty cubic centimetres faintly turbid fluid, containing meningococci. Serum, thirty cubic centimetres intrathecally; thirty cubic centimetres intramuscularly. Radial pulse perceptible, but irregular; became uncountable later in day. February 19, 1917: Feels very well. Neck stiffness very slight. Rash fading. Lumbar puncture, few cubic centimetres perfectly clear fluid. Pulse 98, regular, and good volume. Convalescence interrupted by rise of temperature about twelfth day. Did not settle for about a week. No signs of meningitis. Good recovery. No sequelæ.

Case 3.—W. History of abrupt onset. March 9, 1917: On admission: Quite unconscious. Profuse purpuric rash covering face, trunk and limbs. On left thumb and right toes, hæmorrhage into deeper tissues. No pulse

to be felt at wrist. Heart sounds faint and irregular. Slight neck rigidity. Kernig's present. No abdominal or tendon reflexes. Urine loaded with albumin. No blood. Leucocytosis, 40,000. Cerebrospinal fluid under little pressure; clear, sterile, but slight increase in protein content. Liq. adrenalin, ten minims every four hours. Serum, sixty cubic centimetres intramuscularly. March 10 and 11, 1917: No change in general condition. Cerebrospinal fluid now turbid and contains intra- and extra-cellular meningococci. Serum, thirty cubic centimetres intrathecally; thirty cubic centimetres intramuscularly. March 12, 1917: Pulse at wrist can be felt. Fairly good volume. Line of demarcation round larger purpuric areas. March 16, 1917: Pulse, 128, irregular. Temperature, 101° F. During day temperature rose to 104° F. Died. Post mortem: Meninges free from pus, except choroid glands, which were covered. Adrenals hæmorrhagic.

Case 4.—A., March 12, 1917: Admitted 1 p.m. Quite conscious. Complains of headache. No muscular rigidity. No radial pulse to be felt. Profuse purpuric rash on trunk and limbs. Liq. adrenalin ten minims four hourly. Lumbar puncture thirty cubic centimetres faintly turbid fluid, containing meningococci extra- and intra-cellular. Serum, thirty cubic centimetres intrathecally; thirty cubic centimetres intramuscularly. Breathing became very laboured. Extreme cyanosis. Perspired profusely. No radial pulse. Died 8.15 p.m. Post mortem: Adrenals hæmorrhagic.

Case 5.—De C., March 19, 1917. History of coryza and abrupt onset with unconsciousness. On admission: Unconscious; deeply cyanosed; no radial pulse to be felt; heart sounds weak and irregular; incontinence of urine and fæces; no rigidity; no reflexes; profuse hæmorrhagic rash. Liq. adrenalin twenty minims; ten minims continued four hourly. Lumbar puncture forty-five cubic centimetres clear fluid containing meningococci. March 20, 1917: Conscious; radial pulse regular and fairly good volume. March 21, 1917: Pulse good. Adrenalin discontinued. Case ran an ordinary course. Slow convalescence. Very neurotic.

Case 6.—H., April 1, 1917: Quite unconscious, restless, moaning; neck rigidity and Kernig present. Incontinence of urine and fæces. Respirations fast, laboured; intense cyanosis and very profuse purpuric rash. No radial pulse. Heart sounds feeble and irregular. Liq. adrenalin ten minims intramuscularly every four hours. Lumbar puncture seventy-five cubic centimetres turbid fluid containing meningococci, serum. April 2, 1917: Pulse perceptible at wrist, fast and low pressure. Lumbar puncture fifty cubic centimetres turbid fluid, serum. This case did not respond to treatment. April 6, 1917: Pulse uncountable; respirations, 48, laboured; intense cyanosis. April 7, 1917: Died. Post mortem: Adrenals hæmorrhagic.

Case 7.—I., April 5, 1917. On admission: Unconscious and very restless; intense cyanosis and profuse petechial rash. No radial pulse

to be felt. Heart sounds irregular. Neck rigid. Kernig's sign present. Superficial and deep reflexes lost. Liq. adrenalin ten minims every four hours. Lumbar puncture thirty cubic centimetres turbid fluid containing meningococci; serum, twenty cubic centimetres intrathecally, thirty cubic centimetres intramuscularly. April 6, 1917: Conscious, feels very well. Radial pulse 60. Good. Lumbar puncture, sixty cubic centimetres turbid fluid; serum as before. Treatment continued for three days. Complete recovery.

Case 8.— B. Acute onset day previous to admission. April 19, 1917: Complains of severe headache; neck stiff; Kernig present; profuse hæmorrhagic rash; marked cyanosis; pulse slow, 64, feeble and irregular. Temperature normal. Liq. adrenalin ten minims every four hours. Lumbar puncture forty-five cubic centimetres faintly turbid fluid, containing meningococci, serum. April 20, 1917: Pulse much stronger and regular. Serum treatment continued. Adrenalin stopped. Complete recovery.

Case 9.—M., April 22, 1917: History of very acute onset, commencing with coryza on the previous evening. On admission: Unconscious and very restless. Extreme hyperæsthesia. Deeply cyanosed and quite pulseless at wrist. Heart sounds faintly heard, very irregular. Neck muscles rigid. Kernig's sign present. Incontinence of urine and fæces. Liq. adrenalin ten minims intravenously. Pulse felt at wrist within a few minutes, very feeble and uncountable. Very extensive hæmorrhagic rash, especially on legs and thighs, covering at least one half of the skin surface. Lumbar puncture forty cubic centimetres clear fluid; serum twenty cubic centimetres intrathecally, twenty intramuscularly. Rectal saline. Adrenalin ten minims continued four hourly. April 23, 1917: Pulse fair, 116. Blood pressure low. Lumbar puncture forty-five cubic centimetres faintly turbid fluid; serum twenty cubic centimetres intrathecally; twenty cubic centimetres intramuscularly. April 24, 1917: Pulse good, 94. Lumbar puncture, forty-five cubic centimetres fluid; serum twenty cubic centimetres intrathecally; twenty cubic centimetres intramuscularly. April 25, 1917: Line of demarcation round areas of dead skin caused by rash. Conjunctivitis of right eye. Lumbar puncture, forty cubic centimetres fluid; serum as above. April 26, 1917: Lumbar puncture, forty cubic centimetres fluid; serum as above. April 27, 1917: Lumbar puncture, forty cubic centimetres fluid; serum as above. Iritis of right eye; pupil does not react to light. Atropin instilled. April 28, 1917: Anterior chamber of eye full of pus. April 29, 1917: Anterior chamber opened and pus evacuated. Meningococcus isolated from pus. Areas of skin destroyed by rash have sloughed and left suppurating surface. This gradually is clearing up. Mental condition good.

The above cases were all of the fulminating type, and all, with one exception, were in a pulseless condition on admission. Each received

injection of liq. adrenalin in doses of ten minims to twenty minims of the 1,000 solution, either intravenously or intramuscularly.

In all, with one exception, the radial pulse became perceptible, and with the same exception, recovered sufficiently to run a course not unlike the ordinary acute case so far as the meningeal element is concerned.

Each case was treated by intrathecal and intramuscular injection of antimeningococcal serum, in addition to the injection of liq. adrenalin.

The mortality rate in this series is thirty-three per cent, and while the numbers are far too small to allow one to state definite conclusions, it would appear that the prognosis in cases so treated is more hopeful than that suggested in the opening quotations.

ON THE USE OF ACETOZONE AS A GENERAL SURGICAL ANTISEPTIC.

By Lieutenant-Colonel G. GORE-GILLON.
Royal Army Medical Corps.
AND
Professor HEWLETT, M.D., F.R.C.P.

The important properties of an ideal antiseptic appear to be (*vide* Browning and others, *British Medical Journal*, January 20, 1917):—

(1) Great potency against all micro-organisms in presence of protein material, as serum, etc.

(2) No deleterious effect on phagocytosis.

(3) Innocuous effect on tissues.

(4) Stimulating effect on connective tissue cells so as to promote healthy granulations.

(5) No toxicity.

In benzoyl-acetyl-peroxide we have a preparation that fulfils these conditions.

After previous experience of this substance in my surgical wards, I introduced it into this country in May, 1915, and have used it extensively in London Military Hospitals since then as an antiseptic solution in the treatment of septic wounds. Its formula is $C_6H_5CO\ O\ O\ COCH_3$, and it is known as acetozone. It has been used for years as an intestinal antiseptic in enteric fever and mucous colitis by physicians, and as a throat spray, but its use as a general surgical antiseptic application to wounds is unknown here.

The curative effect of a solution of this drug (*a*) containing five grains to the pint and used cold as a bath (cost is 8d. a gallon at Army prices, and plenty of it is available); (*b*) or a seven-grain solution with one-third hot water added. Its action is very rapid indeed; unhealed amputation stumps heal quickly if put into a bath of this solution for half an hour

daily and dressed afterwards with dressings of sterile lint or gauze soaked in the ten-grain solution.

I have seen numerous cases of septic wounds, which have resisted all other treatment for four or five months, heal up in three weeks by this method.

It can be applied to deep wounds by Carrel-Dakins tubes eight-hourly; by the bath method; or in a waterproof bag; or just dressed two or three times a day with wet dressings of ten-grain strength solution.

Mode of Preparation.

(1) The solution must be made by adding 5 to 7 grains to 1 pint sterile water at 112° F., left to stand for two hours, and SHOULD NOT BE FILTERED.

(2) Or a ten-grain to one-pint solution can be used with dressings or Carrel-Dakins tubes, etc.

(3) In very septic cases, swarming with anaerobes, etc., a twenty- to sixty-grain solution may be used.

(4) It should be MADE FRESH EVERY SEVEN DAYS and the bottle shaken before using.

Pure H_2O_2 is very unstable and momentary in its oxidizing power, while acetozone in solution is a fairly stable antiseptic, and its ozone producing power is prolonged.

Acetozone has a remarkably pleasant, pungent ozonic odour, and the solution is colourless and does not stain linen.

Finally, it is an efficient sterilizer of the skin (used in a twenty-grain solution). It should not be used for the urethra.

Summary of Investigation of Bactericidal Potency of Acetozone.

At the request of Lieutenant-Colonel Gore-Gillon, R.A.M.C., we have carried out a number of tests on the germicidal power of Acetozone (benzoyl-acetyl-peroxide $C_6H_5CO\ O\ O\ COCH_3$). The tests have been done with the *Staphylococcus pyogenes aureus* and *Bacillus mycoides* (the latter as a type of a sporing organism).

Filtered solutions of acetozone were first used; but as the acetozone takes some time to dissolve, and as only small amounts of the substance are used, some undissolved residue is apt to be removed by filtration, and therefore the unfiltered solution was subsequently employed.

When the filtered solution was used the results were not nearly so good as when the unfiltered solution was used.

The method was to mix saline emulsions of the organism with the acetozone solution, kept at 37° C. for a definite time and then to sub-

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culture into broth or on to agar. In some of the experiments broth or serum was added to the mixtures.

Saline Mixtures—Staphylococcus aureus.

Acetozone 1 in 437 and 1 in 583, killed within thirty minutes (*shorter time not tested*), 1 in 875 did not kill in $1\frac{3}{4}$ hours.

Twenty-four hours' Exposure.—Acetozone 1 in 1,744 killed in twenty-four hours, 1 in 4,360 did *not* kill in twenty-four hours. (Three concordant experiments.)

Sporing Bacillus Mycoides.

Acetozone 1 in 291 and 1 in 437 killed within one hour (shorter time not tested).

Twenty-four hours' Exposure.—Acetozone 1 in 872 killed in both of two experiments; 1 in 1,744 killed in one experiment, but did not kill in another experiment; 1 in 4,360 did not kill in two experiments.

Twenty-four hours' exposure in presence of one-third broth or serum (1 vol. acetozone sol. + 1 vol. emulsion of organism + 1 vol. broth *or* serum).

Staphylococcus aureus.

+ Serum	Acetozone:	1 in 437 killed.	
		1 in 654 did *not* kill.	
+ Broth	Acetozone:	1 in 1,744 killed.	
		1 in 4,370 did *not* kill.	

Sporing Bacillus Mycoides.

+ Serum	Acetozone:	1 in 437 nearly killed.[1]	
		1 in 654 did *not* kill.	
+ Broth	Acetozone:	1 in 1,744 killed	Both of two experiments.
		1 in 4,390 did *not* kill	

Meat-broth anaerobic culture from a septic wound containing many sporing bacilli:—

Acetozone: 1 in 290 killed (twenty-four hours' exposure). No other strength tested.

N.B.—Strengths of acetozone between those given were not tested, so that in some instances the numerical germicidal strength may be less than that stated.

The strengths of acetozone given are the actual strengths in the mixtures.

The experiments show that acetozone is quite a potent germicide and is active upon spores.

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[1] There was no growth in the sub-culture after twenty-four hours' incubation, but growth after forty-eight hours' incubation.

Acetozone is practically non-toxic and without irritant effect on mucous membranes, for solutions of five and ten grains to the pint may be freely drunk as a beverage.

5 grains	to the pint	= 1 in 1,750		
10	,, ,,	= 1 in 875		
20	,, ,,	= 1 in 437·5		
30	,, ,,	= 1 in 291·6		Approximately.
40	,, ,,	= 1 in 218 75		
60	,, ,,	= 1 in 145·8		

Lecture.

STORIES FROM THE CAMPAIGNS OF NAPOLEON AND WELLINGTON.[1]

By Colonel C. A. BALLANCE, C.B., M.V.O.
Army Medical Service (Consulting Surgeon).

During the first seventy years of the last century the art of the practical or pre-Listerian surgeon reached its zenith. I may mention a few names. Guthrie, who gained experience in the Peninsular War; Baron Larrey, the great surgeon of Napoleon's armies; Dupuytren, the great Paris surgeon; Astley Cooper, who first tied the abdominal aorta; Syme, and that master of his craft Fergusson. The great morbid anatomists Auvert, Cruveilhier, Bright, Lebert, Hooper and Carswell, lived through the same period and each has left us volumes of beautiful illustrations of disease. How splendid were their labours, how much we are indebted to them! On the sure foundation laid by such patient pathological investigations the more perfect clinical diagnosis of the present day has been built up, and advances in surgery have in great measure been made possible.

My paper this afternoon is almost entirely composed of extracts from the writings of Larrey and Guthrie. These two great surgeons laid down and practised the principles of the treatment of gunshot wounds which are in many phases of our work a sure guide to us at the present time. The examples which I shall quote from their experience will often bring to your minds similar cases which we have had to treat in Malta. Both men worked very hard and both were often in a very tight corner.

[1] A Lecture delivered in the Council Chamber of the Valletta Palace on May 12, 1916, to the Medical Officers of the Malta Command.

When I first entered the profession the surgery of Larrey, Guthrie and other great practical surgeons held the field. The discoveries of Pasteur and Lister had not yet permeated the profession. Since that time I have lived through and been a witness of the wonderful changes and advances which scientific surgery has won over disease and injury in every part of the human body.

The Great French Surgeon, Baron Larrey.

Baron Larrey was a prominent surgeon before Napoleon rose to power. In 1788, before the war with England, he visited Newfoundland as surgeon in a French man-of-war. In order to reach his ship he walked from Paris to Brest. When at Newfoundland he made his first acquaintance with the English, of whom he wrote: "We were astonished at the beauty of the English women whom we met in the course of our walk; almost all were of good stature, well developed and with good figures, pretty hair, pleasant faces, bright eyes and surprisingly white teeth. In some, chestnut hair and eyelashes contrasted agreeably with large blue eyes." On visiting an English man-of-war and witnessing a display of drill and gunnery, given in honour of the visitors, he wrote: "All these manœuvres were remarkable for their precision and rapidity. I derived great pleasure from visiting this ship, where the most perfect order and the most scrupulous cleanliness prevailed. We sat down to table *at noon* with the officers and *midnight* found us still united. Nearly all the English officers spoke French well enough for us to follow the conversation. The Captain had been with Cook in his last voyage around the world, and related to us several of the adventures of this renowned traveller and the manner of his death."

The return journey to France commenced on September 27, and ended on October 31. Bad weather was met with, and there was a shortage of provisions and water. "There only remained a little brandy and one cow in calf, very thin." A Danish ship which was hailed with signals of distress made all haste to get away.

Larrey's advice for keeping the crew in health was good food, cleanliness of the ship, and exercise except during the hours actually devoted to sleep.

He issued Instructions for Restoring the Apparently Drowned.

"I have the patient, he wrote, laid on a mattress in front of a large fire. The clothes are removed, and the body is rubbed unceasingly with warm flannel. I pump in air with a bellows into one nostril while holding the other tightly closed; then I compress the chest and abdomen to drive it out. I put a little warm spirit into the mouth and stimulate the pharynx and nostrils with a feather impregnated with ammonia. I have an enema of warm decoction of tobacco given, and take care to have all aspects of the body turned in succession to the fire in order to warm them

equally and to avoid burns. Bleeding from the jugular is sometimes useful. Emetics and opening the trachea are useless. I continue the effort to resuscitate for about six hours." The use of the bellows reminds me that when I was a student I more than once witnessed the attempt to reduce an intussusception in an infant by means of the kitchen bellows, the nozzle of which was introduced into the rectum.

Larrey accompanied Napoleon on most of his campaigns, including that of Egypt and the retreat from Moscow. The ship on which he had placed most of his stores for the Egyptian campaign was captured by the English on the way out. He observed on the ceilings and walls of Egyptian temples bas-reliefs of amputations performed with instruments very similar to those of his own day. He found also representations of other surgical operations and other surgical instruments in hieroglyphics, by which, said he, "We see that in those ancient days surgery was as much advanced as the other arts, which seem to have been brought to a high degree of perfection."

Larrey advised and practised free incision for hepatic abscess, which he had probably read about in the writings of Jean Louis Petit, a famous French surgeon who died in 1770. He successfully treated some cases of gunshot wound of the intestines. He was, however, much troubled with various diseases and complications. Tetanus, ophthalmia, and plague all required his attention. On one occasion seventy out of a garrison of 300 died of plague. He fully appreciated the danger of sepsis in hospitals as they then were, and when he could he sent his patients right away, however bad they were, the same day, after even severe operations, for he found that in spite of rough transport they did better, whether in the heat of Egypt or the rigours of a Polish winter, when out on the road than when shut up in churches or hospitals. Larrey was so popular among the soldiers that on being recognized in the mass of struggling men on the bridge over the Berisina, he was handed on from soldier to soldier until he reached the other side.

Larrey met with several cases of external anthrax in Egypt, which he treated by removing the gangrenous pustule and applying liquid caustics to the wound. He was much struck by obtaining muscular contractions on stimulating the nerves of an amputated limb. "The results of these experiments," he writes, "led me to hope that electric stimuli applied to the nerves of paralysed limbs would recall them to activity and re-establish their functions."

When he went to the army in Spain he found the two chief surgeons much advanced in age, and one of them nearly blind. He thought this was very wrong.

He gives a Description of a Mine Explosion in his First Campaign.

"The enemy (Spaniards) blew up two of his redoubts which our soldiers had just entered. One can imagine no more frightful spectacle

than this explosion. More than a hundred of our volunteers were within the fortifications when the mines were exploded; they were all blown up with the remains of the stone battlements and of the guns which defended them. Fragments of the artillery, stones, men, or bits of their limbs were carried away pell-mell by the explosion, and fell here and there from a more or less great height."

After this explosion he had four cases in which he amputated two limbs; all recovered, although much burned.

His departure for his next campaign having been postponed, he was detained at Toulon. He utilized the time by giving a course of instruction to the surgeons and students. "Every lecture on anatomy and physiology," he writes, "was followed by illustrative experiments, and all the bodies from the naval and military hospitals were devoted to anatomical preparations and operative surgery." During this time of waiting he also practised in Toulon and the surrounding country.

Larrey gives a Description of Malta.

"The whole island is very well cultivated, although the subsoil is hard limestone. It is mountainous, intersected by small valleys, where the rainfall lodges and the water remains for a greater or less time, and so adds to the fertility of the garden soil, which has been produced on the surface of the rock by labour and manure. The island is covered by terraces of varied shape and size, arranged somewhat like an amphitheatre, and scattered about are very handsome country houses. The table-lands are so many gardens of orange trees, lemon trees, citron trees, fig trees, and most of the fruit trees of Europe. The gardens are planted with the choicest and most beautiful flowers. A great part of the island is devoted to the cultivation of cotton, saffron, and a small quantity of corn and other grains. Nopal, i.e., the cactus, grows wild, and much advantage might be derived from this plant if the cochineal insect were attracted to it. The chief town of Malta is in the middle of the island, and reaches up to the highest point; it is surrounded by impregnable ramparts, and flanked by rows of towers bristling with cannon. The city of Valletta is well built, and the roads to the harbour well kept up. There are several fine palaces, beautiful churches, and a splendid hospital where we placed the few wounded that we had during the siege. The harbour is divided into several basins or canals, very deep, and large enough to take men-of-war; the height of the surrounding rocks shelters them from storms. Our fleet stayed there two days.

"The air of the island and of the town is good and pure, particularly when the wind comes from the west, which is the case for three-fourths of the year, the west wind is cool and moist, it mitigates the burning heat of the day but the dampness renders it injurious at night; the humidity is so great that on remaining out of doors for one hour at night one gets as wet as if in a smart rain. The south winds blow during March, April

and May with some intervals. These are ill winds and favour septic diseases, and during this season the invasion of plague is most to be feared. There is only one source of water for the town and port, the water is good and very clear; cisterns to catch rain water are hollowed out of the rock, this is used for domestic purposes and irrigation."

Camel Broth.

In Egypt on some occasions Larrey was in great straits for food for the wounded. On one occasion he could not get any meat to make soup for his patients so he asked General Reynier for camel meat. "The General gave orders that all camels unfit for service on account of wounds should be reserved for the use of the sick. The meat and the soup made from it were nutritious and quite palatable. But, unfortunately, this supply did not last long, and we were soon obliged to replace camel meat by horse flesh, which is much inferior."

Plague.—State of One of the Forts he had to deal with in Egypt.

On the fort being taken he was sent to render it fit for occupation. "I first sought for the sick and wounded which the enemy had left and found about fifty in the basements without light or fresh air, lying on heaps of putrid rags, without bed coverings and covered with vermin. These unfortunates had received no medical attention, nearly all had no dressings on their wounds, which were gangrenous and full of worms. Some had all the signs of malignant fever, one had a plague bubo in the right groin and another bubo on the leg. The courtyards were choked with human corpses and the bodies of dead animals, especially horses, already putrifying; the soldiers quarters were littered with rags and all sorts of infected and insanitary objects."

Hepatic Abscess.

Larrey had several recoveries, one with communication with pleura. He advised free incision. "The integument is incised in a suitable direction, the muscles and the aponeuroses are divided in the same direction and the abscess is incised to a proportionate extent at its lowest point, care being taken not to disturb the peritoneal adhesions, lest the pus escape into the peritoneal cavity or the intestines protrude. The opening can be extended as far upwards as necessary, or if the cavity is deep, a counter opening can be made."

He relates a case of spontaneous recovery by the abscess bursting into the bowel, but says that such an unusual occurrence must not deter the surgeon from intervention. He also wrote on leprosy, elephantiasis and scurvy, which he observed in Egypt.

Venereal Disease.

There was a serious outbreak in the French army in Egypt. "It was difficult enough to stop the effects of this contagion. In order to remedy

this inconvenience and to stop the spread of syphilis, I proposed to the General the establishment of a civil hospital for the reception of prostitutes affected with venereal disease, and also pregnant women of the same class, so as to prevent the abortion which they habitually induced and to preserve the lives of their children. A large house favourably situated was obtained, where all women suspected of disease were taken, and those found infected were detained and treated with the greatest care. At the same time also a vigorous inspection was made in all the barracks and all infected soldiers were sent to the military hospital and there detained until cured. These measures proved efficacious."

Un-united Fracture.

Larrey did not approve of the treatment proposed by some authors and carried out by several distinguished practitioners, which consisted in exposing the broken ends of the bone, resecting them, placing them in apposition and fixing the limb in an apparatus until union took place. A successful result, he says, is too rare, and he only knew of two instances; one by an English surgeon and one by a French surgeon. "When not able to obtain union the treatment should be abandoned to nature. The patients become accustomed to the deformity, the effects of which diminish with time and exercise."

Clean Dressings.

He is very emphatic about this. He advised that "charpie should be made from new material, beaten and washed."

Embalming Bodies.

He gives a description of the methods of preparing mummies and directions for preserving bodies. The method he advised was soaking the body in a strong solution of mercurial chloride and drying it by heat. "Two glass eyes are then introduced between the lids of the retruded globes, the hair is suitably dyed and the body is painted all over with a lightly coloured varnish, which gives a life-like and fresh appearance to the skin. Thus may be preserved for thousands of years the remembrance and the features of heroes or great statesmen."

The Defeat of the French at Aboukir.

"The signal for battle was given at 4.30 a.m., our columns were set in motion and marched calmly but with determination upon the English entrenchments. The intrepid bravery of our soldiers from the first moments promised victory, and our brave troops would no doubt have conquered had not a series of untoward events, which occurred during the battle and about which I can form no sure judgment, disturbed the order of the fight and arrested their impetus when they had already taken the first entrenchments.

"General Roize was striking terror into even the most distant ranks of

the enemy, when a cannon ball struck him dead in the midst of his soldiers. This misfortune compelled our troops to fall back and soon the whole army was in retreat."

A Difficult Retreat from Suez.

"The fear of being murdered by the troops of the Grand Vizier, compelled us after one day's march in the deserts of Suez to leave the ordinary route and we entered a valley called the 'Valley of the Lost Way,' into which we penetrated with a view of returning to Cairo by the way of Upper Egypt. Not one of us had ever traversed these deserts, of which we hoped every moment to see the end, but it was in vain. We marched for two and a half days over unknown paths, without finding any water to quench the thirst which was tormenting us, and without seeing any trace of human beings. Our provisions were all consumed and we began to despair of ever reaching Cairo. Twenty-one out of 100 persons of our party had already died of thirst, heat and fatigue; seven of these were French. Many animals died in the first few days, and we lost more at every step; at last when despair had maddened many of us, we saw an Arab in the distance, coming towards us, and we hastened, purse in hand, to meet him and begged him to guide us to Cairo by any way by which we could quench our thirst, for we could no longer stand against it. After making known to us our error, and the country we had come through, he took the purse, stroked his beard, and promised to guide us to the capital. We marched on between fear and hope all the rest of that day. Exhausted by want and fatigue we had to stop every quarter of an hour. As night commenced our faithful guide came upon the spring which he had promised to find for us, and we all came to it to drink and fill our water bottles. We could now see Cairo in the distance and reached the city on the second day."

Visit to the English Camp.

After the capitulation of Cairo, Larrey visited the English hospitals. "These ambulances were very well kept and provided with all necessary material, and practice seemed to me to be very successfully carried on there, but I was astonished to find that only three amputation cases recovered although many amputations had been done. This proves again the superiority of French surgery over that of other nations, even the most highly civilized."

Larrey was sent home to France on an English ship, the "Diana," and landed at Toulon.

Projected Invasion of England from Boulogne.

"I had taken all measures necessary to perfect all branches of my service with the Imperial Guard during the sea passage, and after a landing had been effected. The ships resounded with the acclamations of our soldiers who were burning with impatience to set foot on the

enemy shore. It is difficult to express in words how formidable and imposing this force seemed: if we may judge from the movements of the English, they were already terror-struck and seemed unable to avoid the invasion which so sharply threatened them.

"However, amid these preparations, a new continental coalition was formed. . . . . France in her turn was threatened. . . . . In this short interval the allied fleet proceeding to its station encountered that of Admiral Nelson and the terrible and memorable battle of Trafalgar took place. From that moment all was changed."

Health of Troops on the March.

"Snow and rain had constantly accompanied us on our march right up to Vienna, and the rapidity of the marches never allowed the soldiers to dry their clothes. They were deprived of comforts because the waggons were unable to keep up with us and there was even no regular distribution of rations, except in the large towns. In spite of all these discomforts we had scarcely any sick. On the contrary, it seemed that when we entered Vienna the health of the soldier had become more robust. The adult soldier does not fall sick whatever fatigue he has to undergo in a cold climate, provided he is not subjected to long fasting, especially if he has at intervals a few hours' rest. There is some risk in leaving him in complete idleness at bivouac when he has been marching all day exposed to rain or snow. Plunged in the profound sleep naturally induced by cold and fatigue, his vital forces are enfeebled and in a state of suspension, mucous secretions and cutaneous transpiration are diminished, internal absorption on the contrary takes place with the customary activity, the dampness of his clothes penetrates more easily, and thus arises disease, particularly rheumatism. It is fortunate for the soldier that on arriving at his station, though wet and hungry, he is obliged to seek and cut wood for his fire, and to find meat and vegetables for his soup and to prepare it himself. During this exercise he suffers no inconvenience from wet clothes which soon dry at the bivouac fire. . . . It is, then, necessary for the soldier to bivouac, not only in the interests of the inhabitants of the country but of the soldier himself . . . especially when passing through a country so fertile as Germany, where the soldier has never wanted for bread, meat, vegetables, and beer, a drink much better for campaigning than spirituous liquors which the soldier generally abuses.

"The inhabitants of Germany, hospitable and humane as I found them, helped us in every way." (Rather different now!)

Tetanus.

This disease seems to have given a great deal of trouble. Some cases of recovery are related. Larrey strongly recommends amputation for tetanus. He writes: "The section of the limb made on the first onset

of symptoms cuts off all communication from the source of the mischief with the rest of the body, this section disgorges the vessels, puts an end to the dragging on nerves and abolishes the muscular convulsion. These first effects are followed by a general collapse which favours the excretions, disposes to sleep and re-establishes equilibrium in all parts of the body. The sum of the momentary pains caused by the operation cannot increase the existing irritation, and the pains of tetanus render those of the operation more bearable and diminish their intensity, particularly when the chief nerves of the limb at the time of the operation are strongly compressed."

When amputation was not possible he recommended that the actual cautery should be applied to the wound. He must have realized that the source of the poison of tetanus was in the wound.

Nine days after an amputation at the shoulder-joint, symptoms of tetanus occurred and in three days were fully developed; blistering ointment on the wound and large doses of opium had no effect. The actual cautery was applied to the wound. "The application was lively and extremely painful, but it was followed almost immediately by perfect quiet and profuse sweating." The man recovered.

Larrey was without transport for his wounded on one occasion. "Bonaparte ordered that all the horses of the general staff, not excepting his own, should be used for the transport of wounded."

Small-pox.

"It is much to be regretted," Larrey writes, "that while we were in Egypt we did not know of the important discovery of Jenner."

Typhus.

Larrey met with a severe endemic disease, probably typhus at Brunn. "The fever hospitals were soon overcrowded and the mortality proportionately great. At the same time the epidemic broke out among the Russian prisoners, whom we were obliged to house in great numbers in churches and other large buildings, lastly it spread to the populace and extended along the whole line of communication, even into France."

Aneurysm (non-traumatic).

This he attributed to syphilis, and says it does not occur in men who are engaged on laborious occupations if they lead a sober life, "and no vice circulates in their humours. The syphilitic virus sets up irritation at some point of the arterial inner coat. A sort of latent inflammation is started, the resilience of the arterial inner coats is enfeebled, and as a result of the alteration of the texture the arterial wall yields before the blood pressure." (Quite as good a description of syphilitic arteritis as could be found now.)

Amputations.

"Now that our art has, through twenty years of continual war, been brought to the highest possible point of perfection, we ought to have but one opinion on this subject." Larrey regarded the question whether in gunshot injuries of the limbs amputation should be performed at once, or deferred, as the most important point in military surgery.

"While Faure tells us that after the battle of Fontenoy out of about 300 amputations only about thirty survived, we saved more than three quarter of our amputation cases, although several lost two limbs. We attribute this success (1) to a better appreciation of the indications for operation and of the most favourable time for operating; (2) to more methodical dressings; and (3) to a more simple, rapid, and less painful method of operating."

In amputations in military surgery he adopted the circular method, and made little or no attempt to unite the wound; suppuration and separation of ligatures were regarded as normal and inevitable, and in a few instances in which the ligature was retained he deliberately removed it.

Larrey recommended immediate operation whenever amputation is necessary. "The first twenty-four hours is the only time of calm reserved by nature, and we must hasten to take advantage of it, as in all dangerous diseases, to administer the necessary remedies."

He gives eight indications for amputation:—

(1) Limb torn off.

(2) Bones fractured with much damage to soft parts.

(3) Much loss of soft parts with damage to vessels, even without injury to bone.

(4) Fracture with damage to muscles, and chief nerves, even without injury to artery.

(5) Fracture with injury to great vessels without external injury (after extent of injury has been verified by incision).

(6) Fracture extending into ankle or knee-joint.

(7) When a bullet or splinter of shell has passed through a limb and denuded a large surface of bone, even though the soft parts do not seem much injured.

(8) When a large hinge joint, particularly the elbow or knee, has been opened. The indication is not so strong in ball and socket joints, such as the shoulder or wrist.

"After the naval engagement of June, 1794, a large number of immediate amputations were done; sixty of these were taken to the Naval Hospital at Brest; all recovered except two, who died of tetanus. But the surgeon of the Téméraire, which was taken by the English, put off operation, which was indicated in several cases, on the advice of the English surgeons, and had the mortification of seeing them all die on the voyage."

In amputating at the hip joint he first tied the common femoral, a precaution which Guthrie despised.

Among the multitude of cases which Larrey records I have time only to mention a few :—

Case of Multiple Wounds, Recovery.

Seven very deep sabre wounds, two on the shoulders, divided the muscles and part of the scapula, one on the back divided the muscles and two of the dorsal spinal processes. This soldier also had a bullet wound in the chest, with lodgment of the bullet and effusion of blood in the pleura, for which the "operation for empyema" was done. The man recovered.

Wound of External Carotid.

"A general's aide-de-camp was struck by a bullet which divided the external carotid at its point of separation from the internal, and where it passes into the parotid. The fall of the wounded man and a considerable jet of blood which spurted from the two openings arrested the attention of two gunners. One of them, a very intelligent man, had the presence of mind to plug the wound with his fingers, and thus stopped the hæmorrhage. I was sent for immediately and ran to give help in the midst of bullets and cannon balls. A compressive bandage, methodically applied, to my great astonishment, arrested the rapid advance of death, and saved this officer. This is the first well authenticated example of cure of a similar wound." (Would a compress permanently stop hæmorrhage from a divided external carotid ? It scarcely seems possible.)

(*To be continued.*)

Current Literature.

German Medical Congress at Warsaw. (Verhandlungen der ausserordentlichen Tagung des Deutschen Kongresses für innere Medizin in Warschau am 1 und 2 Mai, 1916.)

(*Continued from page* 730.)

Dr. Goldscheider, following on Hünermann, gave some statistics as to the protective value of inoculation. In December, 1914, and in January, 1915, the percentage of mild and abortive cases amongst the uninoculated was fifteen ; amongst the inoculated the mild and abortive cases constituted twenty-six per cent of the attacks. With increasing practice of inoculation the percentage of mild and abortive cases of typhoid fever increased, so that during the period, October, 1915, to April, 1916, 69·6 per cent of the cases of typhoid fever occurring in those

who had been inoculated three times were of this character. During this period the case-mortality of typhoid fever fell to 2·3 per cent. Professor Kaup spoke as to the protective effect of antityphoid inoculation, as observed in the Austrian armies. The protective effect of inoculation had not been marked so strongly in typhoid fever as had been the case with cholera. But, nevertheless, the incidence of typhoid fever had been much heavier amongst the uninoculated, in whom the disease had also been much more severe. Before inoculation was practised, the case-mortality for all the armies was between thirteen and sixteen per cent. (In the army of the Carpathians the case-mortality was between twenty and twenty-five per cent in the winter of 1915.) After inoculation was practised generally, the case-mortality fell to five or six per cent, and in some armies had been only two or three per cent. It appeared that the protective effect of inoculation was lost after some seven or eight months. In the Austrian armies, therefore, re-inoculation was carried out every seven months. Dr. Stintzing agreed generally with Professor Kaup in his appreciation of the value of antityphoid inoculation. Dr. Friedberger had observed that typhoid infection in the inoculated was accompanied by reddening and tenderness of the skin at the seat of vaccination, and thought that this phenomenon might be of value in the early diagnosis of typhoid fever occurring amongst the inoculated. Dr. Conradi was of opinion that culture in bile provided the best method for isolating typhoid bacilli from the blood; culture of the exudation of the skin eruption was useful in the diagnosis between typhoid and typhus fevers. If, drawing of blood having been avoided, cultures were made from the exudation from the upper layers of the skin over rose spots, typhoid bacilli were often isolated in cases in which blood culture failed. Dr. Singer agreed as to the value of cultures from the exudation of the skin eruption, more especially now when the diagnostic value of Widal's test had been obscured by the effects of preventive inoculation. Dr. Meyerstein referred to the effects of antityphoid inoculation on the kidney. Amongst 150 men who had been inoculated for the first time, albuminuria was of exceptional occurrence; and then only after the third vaccination. On subsequent re-inoculation, however, eighty per cent of the cases showed a transient albuminuria. Dr. Meyerstein thought that this transient albuminuria was caused usually by the injection of the bacterial proteins. Dr. Munk referred to the probability of isolation of the typhoid bacillus from the blood in cases of varying degree of clinical severity. The typhoid bacillus could be isolated from the blood in sixty-three per cent of the cases diagnosed clinically as being cases of typhoid fever. The death-rate amongst cases in which the clinical diagnosis had been confirmed thus was twenty-two per cent. In the residue of cases diagnosed, on the clinical symptoms, as typhoid fever, and in which the specific bacillus could not be isolated from the blood, the case-mortality had been ten per cent. The probability of isolating the typhoid bacillus from the blood increased with increasing severity of the symptoms. In "mild" cases the bacillus had been isolated in fifty-two per cent of the examinations; in "moderately severe" and in "severe" cases the bacillus could be found in the blood in sixty-two and seventy-three per cent respectively. Fifty-seven per cent of cases of typhoid fever amongst the uninoculated would be classified clinically in the "severe" type; and

positive results on culture of the blood were obtained in sixty-eight per cent. Amongst the inoculated about twenty-four per cent were of the "severe" type, and the bacillus could be isolated from the blood in about sixty-two per cent of this group.

(5) *Paratyphoid Infections.*—Professor Stintzing, opening a discussion on paratyphoid infection, said that paratyphoid infection of the B type had been distributed widely over every front but, together with infection by *B. enteritidis* (Gärtner), had been especially common on the Flanders front. The cases occurred sporadically; there had never been any serious epidemic outbreak. The greatest prevalence was from June to August; but large numbers of cases occurred in the months of October, 1915, and January, 1916. (Typhoid infection was not followed by immunity against paratyphoid disease; and not infrequently two, or occasionally all three, of the enteric bacilli were present in one case.) These cases of mixed infection were usually of a severe type, and it appeared that the bacilli were persistent in the fæces longer in these cases than was usual in single infections. Paratyphoid A infection had been much less frequent, and cases had occurred in small epidemic groups. The disease occurred first in October, 1915, amongst colonial troops, and there had not been any cases since February, 1916. The incubation period in paratyphoid B fever was uncertain, but when food appeared to be the source of infection the incubation period might be from less than twenty-four hours to two or three days. The incubation period in paratyphoid A fever was longer, and probably averaged between twelve and fourteen days. Paratyphoid B fever usually commenced with rigors. The roseolous skin eruption was often absent, but when it occurred the rash was often more extensive, and the individual spots larger, than was the case in typhoid fever. Herpes labialis was common, and the spleen was usually enlarged. The pyrexia was not usually of the continuous type; and usually ended irregularly. The duration of the fever was from one to three weeks as a rule; but might be much longer. Delirium was seldom present, and the pulse rate was comparatively slow. Relapses had occurred in about seven per cent of the cases, and complications were not infrequent—they included bronchitis, broncho-pneumonia, pleurisy, empyema, and myocarditis. The specific bacilli usually disappeared from the fæces at the end of three weeks, but might be present in the fæces and urine for much longer—in one case they had persisted for forty-one weeks. The cases usually went back to the army after fourteen weeks—the longest period of detention had been forty-seven weeks. The death-rate from paratyphoid fever had been as high as 1·2 per cent in some armies; in other armies there had not been any deaths from this disease. Men were not returned to the army after paratyphoid A fever until after ten examinations of the excreta had given negative results.

(6) *Dysentery.*—Professor Matthes, opening the discussion on dysentery, referred to the difficulty in diagnosis between dysentery and simple diarrhœa. Physicians differed in their definition of dysentery, and the bacteriological examination was frequently negative in cases which the clinician would regard as being cases of dysentery. Apart from the bacteriological diagnosis, the test was that of infectiousness. Cases of diarrhœa associated with the presence of bacilli other than the dysentery bacilli did not spread; cases of apparently simple diarrhœa which spread

through hospital wards, and amongst hospital attendants, must for practical purposes be considered as cases of dysentery. The dysentery bacilli were rarely found in the blood. In one series of examinations of convalescents from dysentery it had been found that in seventy-three per cent of the cases the blood agglutinated either the true or "pseudo" dysentery bacilli, whilst the bacilli themselves were found in the fæces of only eleven per cent. Professor Kruse, tracing the history of dysentery since the Franco-German war of 1870-71, said that dysentery of the severe type had been very prevalent through that war, and amongst the civil population afterwards. This type of dysentery disappeared from Germany gradually, and had occurred only occasionally between 1900 and the commencement of the present War. Dysentery of this type, associated with the Shiga-Kruse bacillus, again became prevalent in 1914, but had not affected the troops so severely as it did in the previous war. In the war of 1870-71 the rate amongst the troops had been much heavier than it had been during the present War, whilst the case-mortality had been six per cent. Kruse recognized only two types of dysentery, (1) true dysentery of a severe type, caused by the Shiga-Kruse bacillus, and (2) "pseudo" dysentery of a milder type; occurring especially amongst troops and amongst children, and caused by the "pseudo" bacillus of Flexner. Amongst 300 cases of dysentery examined bacteriologically, not more than between twenty and twenty-five per cent were cases of true dysentery. Mannite broth, the reaction being taken after two days incubation at 37° C., was relied upon in testing between the "true" and the "pseudo" dysentery bacillus. The blood from cases of true dysentery was often more active in the agglutination of the "pseudo" bacillus than in agglutination of the Shiga-Kruse bacillus; but the blood from a case of "pseudo" dysentery never agglutinated the Shiga-Kruse bacillus. In testing for agglutination in dysentery it was essential that the blood should be quite fresh. Healthy carriers did not play any important part in the dissemination of dysentery, but chronic cases of the disease were dangerous. Because of the great severity of the local reaction, protective inoculation against dysentery was not advised. Subsequent speakers emphasized the very frequent difficulty in finding specific bacilli in what appeared clinically to be cases of dysentery. Dr. Pick had not found dysentery bacilli in more than twenty-one per cent of the cases examined. He had not been able to trace any association of the relative severity of the symptoms with the particular type of bacillus isolated. He also had found that a positive agglutinative reaction with Flexner's bacillus did not exclude infection by the Shiga-Kruse bacillus. Dr. Lucksch advocated preventive inoculation with Paltauf's acidified vaccine, by means of which the severity of the local reaction was much modified. Dr. Petruschky had found that administration of the vaccine by means of inunction was effective, and did not produce any harmful results.

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Original Communications.

REPORT ON THE TREATMENT OF FIFTY-NINE CASES OF *ENTAMŒBA HISTOLYTICA* INFECTION.

By R. E. SAVAGE.
Protozoologist attached Royal Army Medical Corps.

WITH

CLINICAL REMARKS.

By CAPTAIN J. R. YOUNG.
Royal Army Medical Corps.

FROM August 1, 1916, to February 28, 1917, fifty-nine cases of *Entamœba histolytica* infection have been treated. Most of the patients acquired their infection in Mesopotamia, Salonica or Egypt, but some had their first attack on Gallipoli in the winter of 1915. Thirty-seven of the cases were cyst carriers, while twenty-two were acute cases.

In this report the term "cyst carrier" is used to denote cases (*a*) which have had acute amœbic dysentery and been either incompletely cured and were passing the encysted forms of *E. histolytica* in their stools; or (*b*) those who were passing cysts but had never had any clinical symptoms of amœbic dysentery.

An "acute" case is so called if the large entamœbæ, with included red blood corpuscles, are found.

A case is described as "cured" if the stools have been free of infection for about four weeks after the conclusion of the emetine treatment.

Entamœbæ which had no included red cells have never been diagnosed as either *E. histolytica* or *E. coli* unless accompanied by

cysts. If no cysts were found other stools were examined until either the cysts or the typical entamœbæ appeared. In adopting this method of procedure we were guided by the recommendations of Lieutenant-Colonel Wenyon, R.A.M.C.

The stools of patients were examined daily whenever possible, both during emetine treatment and for about one month afterwards.

Five different courses of treatment have been tried as follows:—

(1) Emetine hydrochloride hypodermically one grain daily for twelve days.

(2) Emetine hypodermically one grain, and pulv. ipecacuanha five grains daily for twelve days.

(3) Emetine hypodermically one grain and orally ½ grain daily for twelve days.

(4) Emetine bismuth iodide two to three grains daily, thirty to thirty-six grains in all.

(5) Emetine hydrochloride hypodermically one grain and emetine bismuth iodide one to two grains daily for twelve days.

The results of each method of treatment will be described separately.

(1) Hypodermic Injections of Emetine Hydrochloride.

Nineteen cases were given emetine injections alone; sixteen were given one grain daily for twelve days; two, one grain for seven days; and one was given twelve grains in daily doses of half to one grain over a period of sixteen days. Three of the cases were acute and the others were cyst carriers. (Table II.)

The results can be summarized thus:—

	Cyst carrier cases	Acute cases	Average period negative
Cured ..	8	1	33 days
No reaction	3	—	—
Relapsed	5	2	9

Three of the uncured cases (Nos. 2, 4 and 10) were military prisoners. They were afterwards given five grains of pulv. ipecacuanha daily for about seven days; in each case the infection disappeared and after four negative examinations they were discharged. In another case (No. 11), also a prisoner, a few cysts were found four days after the conclusion of the emetine treatment but not afterwards; he was negative for eleven days before discharge.

The other four uncured cases were given another course of treatment. (See below.)

(2) Emetine Hydrochloride Injections and Pulv. Ipecacuanha.

Five grains of pulv. ipecacuanha were given daily to seven patients, in addition to one-grain injections of emetine hydrochloride. On the average eighty grains of pulv. ipecacuanha were given in all and twelve grains of emetine. The results were remarkably good. (Table III.) There were six cyst carrier cases—five of which were cured, and one relapsed after being negative for two weeks. The only acute case treated was cured.

(3) Emetine Hydrochloride hypodermically and Orally.

Four cases—three cyst carriers and one acute—were given one-grain injections of emetine and ½ grain orally daily for twelve days, and all were cured. (Table IV.)

(4) Emetine Bismuth Iodide.

A supply of the new emetine compound—emetine bismuth iodide—reached the hospital in October, 1916.

Dr. H. H. Dale [1] of the Medical Research Committee first had cases of *E. histolytica* infection which had proved resistant to emetine hydrochloride, treated with this drug. Subsequently Dr. Low and Mr. C. Dobell [2] and Mr. C. Dobell [3] described the treatment of other cases. Uniformly successful results were obtained by these workers upon cyst carrier cases; only two acute cases are reported on, both of which were cured.

Thirty-three cases of *E. histolytica* infection treated with this drug are described in this report; seventeen were cyst carriers, and sixteen were acute cases. Thirty to thirty-six grains (= ten to twelve grains of emetine hydrochloride) were given in daily doses of two to three grains. (Table V.)

(*a*) *Cyst Carrier Cases.*—Thirteen of the seventeen cyst carrier cases treated with emetine bismuth iodide had previously been given emetine hypodermically—five of them in this hospital. Only one of the four who had not had emetine had no history of dysentery.

Fourteen cases have been discharged as cured, their stools having been free of infection on the average for forty-three days with an average number of forty-one consecutive negative examinations.

One patient relapsed after being negative for twenty-one days, and in the two others the infection was scarcely affected by the treatment. All of these three cases had a long history of dysentery

and had previously had between sixty and seventy injections of emetine. (Cases 31, 41, and 42. Table V.)

(*b*) *Acute Cases.*—Sixteen acute cases were treated with emetine bismuth iodide. Eleven had previously been given emetine injections. Only one had been given emetine in this hospital and he relapsed, cysts reappearing in the stools. The other fifteen cases were passing blood and mucus stools when the emetine bismuth iodide treatment was commenced. Only one of the five cases not previously treated with emetine had no history of dysentery.

Eight cases were discharged as cured after being negative for an average of forty days with thirty-nine consecutive examinations. Six cases relapsed—four with cysts in the stools and two with amœbæ. In the other two there was no appreciable effect on the infection.

(*c*) *Second Course of Emetine Bismuth Iodide.*—Three of the uncured cases—one cyst carrier and two acute cases—were given a second course of emetine bismuth iodide. The cyst carrier relapsed after being for a second time negative for twenty-one days. One acute case was cured, and one relapsed again. The latter case (No. 53) really had a prolonged course of seventy-two grains because his second course commenced the day after his first finished. (Table VI.)

(5) Emetine Hydrochloride hypodermically and Emetine Bismuth Iodide.

Eight of the cases which were not cured by the double iodide—two cyst carriers and six cases that had been acute—were then given emetine hydrochloride, one grain injection daily along with from one to two grains of emetine bismuth iodide, for twelve days. (Table VII.) Four of the uncured acute cases had passed into the cyst-carrying stage while the other two were still passing entamœbæ. The results were very disappointing. One cyst carrier relapsed and one was cured. Five of the acute cases relapsed and one only was cured.

Two new cases (Nos. 58 and 59) of acute amœbic dysentery were also given this course. Both patients had previously had amœbic dysentery and been treated with emetine. One was cured and the other relapsed, cysts again reappearing in the stools.

A summary of the treatments described above is given in the accompanying table:—

TABLE I.—SUMMARY OF THE RESULTS OF THE TREATMENT OF FIFTY-NINE CASES OF *Entamœba histolytica* INFECTION.

		Cured	Relapsed	No reaction	Total
I. Emetine injections ..	Carriers..	8	5	3	16
	Acute ..	1	2	–	3
II. Emetine injections and pulv. ipecacuanha	Carriers..	5	1	–	6
	Acute ..	1	–	–	1
III. Emetine injections and orally	Carriers..	3	–	–	3
	Acute ..	1	–	–	1
IVA. Emetine bismuth iodide	Carriers..	14	1	2	17
	Acute ..	8	6	2	16
IVB. Emetine bismuth iodide (second course)	Carriers..	–	1	–	1
	Acute ..	1*	1	–	2
V. Emetine injections and emetine bismuth iodide	Carriers..	1	1	–	2
	Acute ..	2	6	–	8

* Since writing this report, Case 53, reported as cured by a second course of emetine bismuth iodide, has been readmitted to hospital with a relapse.

From these results it will be seen that emetine hydrochloride injections effected cures in fifty per cent of the cyst carrier cases treated, while with emetine bismuth iodide the percentage was increased to 82·3. As was pointed out above the only cases uncured by the double iodide were men who had had repeated courses of emetine. The results, therefore, show a close correspondence with those obtained in England. In some of the cases treated with the new drug, the disappearance of the cysts from the fæces was quite remarkable, as prior to such treatment the stools were rarely negative for more than a few days (see Diagrams 2, 3 and 4).

With the acute cases the results are not so good. When the emetine bismuth iodide was introduced it was only expected to be effective in the cyst carrier cases, but after the success obtained in this direction a trial with the acute cases was indicated. A comparison with the emetine results cannot properly be made as only three acute cases were treated with the hydrochloride—one being cured and two relapsing. With the emetine bismuth iodide fifty per cent were cured, which is probably as good as has been obtained previously with acute cases which have had their stools examined systematically.

It was confidently expected that a combination of emetine hydrochloride hypodermically with emetine bismuth iodide would be more successful than the latter drug alone, judging from

previous results with emetine hypodermically and orally, and emetine with pulv. ipecacuanha, but the results were astonishingly poor. Only twenty-five per cent of the acute cases were cured. The number of cases treated was of course very small, so that reliable deductions cannot be made.

One interesting fact brought out in these results is that patients who had not previously had emetine injections were cured by the new drug. Of nine such cases, eight were cured, the one failure being an acute case.

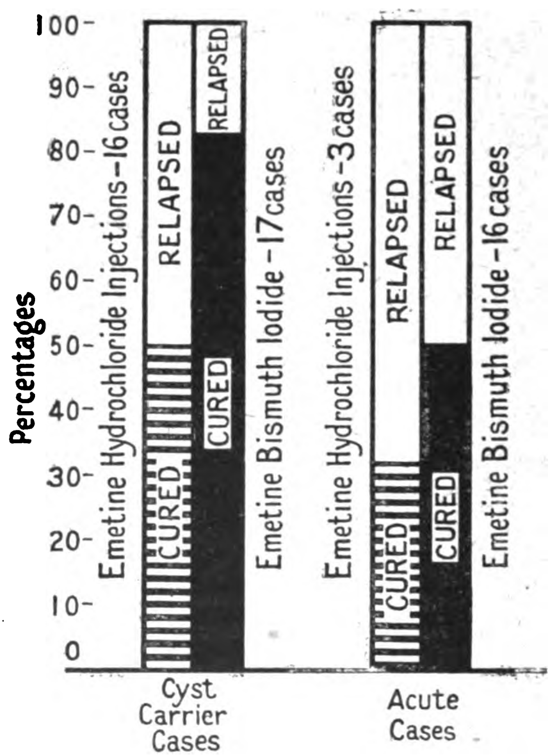


DIAGRAM 1.—Comparison of results of treatment by emetine and emetine bismuth iodide.

The average time taken for the cysts of *E. histolytica* to disappear from the fæces of the cyst carrier cases after treatment was commenced was 7·5 days for emetine hypodermically and 4·7 days for emetine bismuth iodide, while the entamœbæ of the acute cases disappeared after seven days of treatment with emetine bismuth iodide.

A point of much importance is the interval of time that the stools of a patient were free of infection before a relapse took place. With emetine hypodermically the stools were negative in cyst carrier cases for nine days on the average and in acute cases for only 4·5 days. With emetine bismuth iodide the period was prolonged; the only cyst carrier in which a relapse took place was negative for twenty-one days before both his first and second relapse; the acute cases were negative for periods varying between fourteen to thirty days, the average time being twenty-one days. Two of these latter cases were negative for thirty days before they relapsed; had they been negative for a few days longer they would both have been discharged as cured.

It is evident then that a patient cannot be said to be cured of his infection unless his stools have been examined up to the fourth week after treatment has commenced. With the cases described here it has been possible to examine the stools daily, so that a relapse has been detected at once, but it is often not practicable to make very frequent examinations. Occasional examinations should be made up to the third week after treatment has commenced, and more regular ones during the next two weeks. In the stools of acute cases there are frequently small flakes of blood and mucus adhering to the fæcal matter; it is advisable when such are found after the emetine course has finished to send the stool for protozoological examination, as there are often numbers of entamœbæ in the mucus.

Tables II to VII have been prepared to show concisely the particulars of treatment of the individual cases. Further details of typical cures and relapses of cyst carriers and acute cases treated with emetine bismuth iodide are appended.

Case 6. (Cyst carrier case cured.) See Diagram 4.—This patient had his first attack of dysentery at Suez about a month previous to admission to hospital. No emetine treatment was given. *E. histolytica* cysts were found in his stool on September 17. Emetine hydrochloride injections, one grain daily, were given from September 18 to 29. The cysts were only slightly reduced in numbers and the infection increased immediately treatment ceased. Pulv. ipecacuanha five grains daily was given for ten days without effect. Emetine bismuth iodide, one to two grains daily, was given from October 25 to November 11, thirty grains being given in all. The infection gradually diminished, and eleven days after the commencement of the course the stool was free of cysts, and remained negative for thirty-seven days, when the patient was discharged.

Diagram 4 shows graphically the effect of the different courses of treatment on the infection. It will be noticed that previous to the administration of emetine bismuth iodide the stools had never been negative for more than two successive days.

Case 31. (Cyst carrier case relapsed.) Diagram 8.—Had dysentery at Mudros in November, 1915; no emetine treatment given. Was sent to Mesopotamia after discharge from hospital, and had another attack on voyage out. Had thirty-two emetine injections in hospital at Basra, and was then sent to India where he had a further twenty-eight injections. Admitted to this hospital in November, 1916. *E. histolytica* cysts were found in his stool on November 24. Emetine bismuth iodide was commenced on November 27; two grains daily were given for fifteen days. The cysts disappeared after three days of treatment, and the stool was negative for twenty-one days. On December 21, cysts were again found. A second course of emetine bismuth iodide was commenced on December 31; three grains daily were given this time for twelve days. The infection disappeared from the stools after two days of treatment, but after being negative again for twenty-one days cysts were again found, and on one occasion entamœbæ with included red cells were also present. On February 5, he was given one grain of emetine hydrochloride hypodermically along with two grains of emetine bismuth iodide, and this was continued until February 16 (twelve days). Cysts and amœbæ disappeared from the fæces after four days of treatment, but after being negative for fifteen days cysts again reappeared. On February 27, a new course of treatment was commenced—viz., 1½ grains of emetine hydrochloride hypodermically, and five grains of pulv. ipecacuanha daily for twelve days. After four days of treatment the stools were free of cysts and remained negative for forty-one days.

The two cyst carriers (Cases 41 and 42) whose infections were not affected by the double iodide were old cases. Case 41 had attacks of amœbic dysentery on Gallipoli in August, 1915, at Salonica in November, 1915, and in Mesopotamia in August, 1916. He had altogether between sixty and seventy injections of emetine hydrochloride. Case 42 had his first attack in India in 1910, a second on Gallipoli in November, 1915, and again in Mesopotamia in October, 1916. He also had about sixty to seventy injections at different times. Both cases were subsequently cured. Case 41 with emetine injections along with emetine bismuth iodide (Table VII) and Case 42 with daily injections of 1½ grains of emetine hydrochloride and ½ grain by mouth, continued for twelve days.

Case 50. (Acute case cured.) See Diagram 12.—Had bacillary dysentery at Salonica in October, 1916. Had serum but no emetine. Admitted to this hospital passing blood and mucus. Large numbers of *E. histolytica* were found in stool on January 4, 1917. The bacteriological report was also positive, *B. dysenteriæ*, mannite-fermenting group. Emetine bismuth iodide, three grains daily, were given from January 5 to 16 (thirty-six grains). The patient ceased to pass blood and mucus after four days, and entamœbæ after eight days. The stools remained free of *E. histolytica* for thirty-six days, during which period they were examined every day.

Case 18. (Acute case relapsed.) See Diagram 10.—Never had dysentery before. Admitted passing blood and mucus. Large numbers of *E. histolytica* were found on October 2, 1916. Emetine hydrochloride, one grain hypodermically, was given daily for twelve days. The entamœbæ disappeared at once, but a few were found on the last day of treatment. Five days later a few cysts were found and again six days afterwards; the infection increased daily and was very heavy on October 28, when a course of thirty grains of emetine bismuth iodide was commenced. One to two grains a day were given. After nine days of treatment cysts and entamœbæ disappeared. After being negative for eighteen days cysts again appeared. Pulv. ipecacuanha five grains a day were given without effect. On December 31, a second course of emetine bismuth iodide was commenced, three grains being given daily for twelve days. After being negative for sixteen days cysts were again found.

Effect of Emetine Bismuth Iodide on other Intestinal Protozoa.

Twenty of the cases of *E. histolytica* infection treated with emetine bismuth iodide had other protozoal parasites present. The drug had practically no effect upon them. Eight had *Entamœba coli*, four had lamblia, ten had tetramitus, four had trichomonas, and two had *Coccidium isospora*. The infection in one case of *E. coli* and one of tetramitus disappeared under treatment, and in another case of *E. coli* there was a temporary disappearance of the infection.

Summary.

(1) Emetine hydrochloride injections were given to nineteen cases of *E. histolytica* infection—sixteen cyst carriers and three

acute cases. Fifty per cent of the former were cured, and 33 per cent of the latter.

(2) Emetine injections in conjunction with (*a*) pulv. ipecacuanha, and (*b*) half-grain emetine orally, were given to seven and four patients respectively, with very good results. Six of the former were cured, and all the latter.

(3) Emetine bismuth iodide was given to thirty-three cases—seventeen cyst carriers and sixteen acute cases. 82·4 per cent of the cyst carriers were cured, and 50 per cent of the acute cases. The results in the cyst carrier cases corroborate those obtained in England.

(4) Emetine one-grain injections along with emetine bismuth iodide one to two grains daily were given to (*a*) two cyst carriers uncured by emetine bismuth iodide—one was cured, the other relapsed; (*b*) six acute cases uncured by the double iodide alone—only one was cured, and the other five relapsed: and (*c*) two acute cases not previously given emetine bismuth iodide—one was cured, the other relapsed.

(5) Patients who have not previously had emetine injections appear to be cured with the double iodide, whether they are cyst carriers or acute; 88·9 per cent of such cases were cured.

(6) Emetine bismuth iodide causes the infection to disappear more quickly from the stools than does emetine hydrochloride, and appears to prolong the negative period before a relapse, and, consequently, a longer period of control seems necessary.

(7) Acute cases were negative on the average for twenty-one days before relapsing after treatment with emetine bismuth iodide.

(8) Emetine bismuth iodide has practically no effect on intestinal protozoal infections other than *E. histolytica*.

Note.—Since writing the above report, *E. histolytica* cysts have been found again in the stools of Case 7, one of our first "cures" with emetine bismuth iodide. This patient had a course of twelve grains of emetine hypodermically, but was not cured. He was given a course of thirty grains of emetine bismuth iodide (one to two grains daily) from October 25 to November 11, 1916. No cysts were found after October 30 up to the time he was discharged from hospital on December 10—forty-two days, during which period the stool was examined every day. He was out of hospital for thirty-nine days, and then readmitted with bacillary dysentery on January 19, 1917. After he had ceased to pass blood and mucus, he had persistent diarrhœa, which lasted for about seven weeks. During the whole period he was in hospital the second time his

stool was examined daily. On the fifty-third day (March 12) 132 days after his last positive, and when his diarrhœa had ceased, cysts of *E. histolytica* were found. It is impossible to say whether this is a case of reinfection or a relapse, but one is inclined to think it is the latter, because the chances of reinfection while in hospital in a ward where there were no other cases of *E. histolytica* infection were small:—

REFERENCES TO LITERATURE.

[1] DALE. "Treatment of Carriers of Amœbic Dysentery," *Lancet*, July 29, 1916.

[2] LOW and DOBELL. "Three Cases of *E. histolytica* Infection treated with Emetine Bismuth Iodide," *Lancet*, August 19, 1916.

[3] DOBELL. "Incidence and Treatment of *E. histolytica* Infection," *Brit. Med. Journ.*, November 4, 1916.

CLINICAL REMARKS ON THE TREATMENT OF AMŒBIC DYSENTERY WITH EMETINE BISMUTH IODIDE.

In discussing the treatment of patients who are infected with *Entamœba histolytica*, it has become the custom to divide the cases into three groups: (1) acute amœbic dysentery; (2) convalescent carriers; (3) contact carriers.

It is with cases of the first and second classes that we have been dealing.

Concerning the latter class, we think the term "convalescent carrier" is apt to be misleading. It is certainly more honest to look on these as acute cases which we have failed to cure, and which may again develop acute symptoms.

As the emetine bismuth iodide has been administered to both classes in the same manner, we may consider the effects of the drug first on the individual before discussing its effects on the disease.

This drug has generally been given in one-grain doses twice or thrice daily. Most of the cases have had the larger daily dose continued until thirty-six grains had been taken.

The tabloids being keratine-coated are expected to pass through the stomach and be dissolved in the small intestine, thus freeing the drug near the site of the disease, and minimizing the chance of nausea and vomiting.

It may be said quite frankly that our experience has been that this drug in most cases does cause a good deal of vomiting irrespective of the method of administration.

The method we have adopted now as giving the least annoyance to the patient is as follows:—

One tabloid given twenty minutes after a cup of cocoa at 10 a.m.

One tabloid given twenty minutes after the usual ward tea at 4 p.m.

One tabloid given twenty minutes after a cup of cocoa at 8 p.m.

In different cases the drug has been given experimentally with all the different meals with only one definite result, namely, that given after the midday dinner vomiting occurs sooner and more regularly than is the case with the other meals.

In the method described above we find that the patients can make certain of retaining their breakfasts and their dinners long enough for assimilation to take place.

Vomiting has varied considerably in frequency in different patients, and we have found it almost impossible to tell when it might be expected to occur in relation to the dose.

In some cases no vomiting has occurred for four hours after the dose. The average has been one to two hours after the dose, and a few people have vomited within fifteen minutes of swallowing the tabloid.

In some cases a tolerance seems to be established after the first five or six doses; in others vomiting occurs right through the course. One of our patients vomited thirty-five times; the only pill which did not cause vomiting was the last one of the course.

One of our cases who had no vomiting—and, indeed, almost no nausea—explained, when half-way through the course, that he had chewed his tabloids, as he had always a great difficulty in swallowing anything in pill form. In this patient the drug had as curative an effect as on any other case which we have treated.

Impelled by curiosity, we gave several patients the tabloids previously ground up into powder. Here, again, we met with variable results. Some patients who vomited after the entire tabloid retained the powdered one. All, however, preferred the entire tabloid on account of the nasty taste of the powder. In no case have we been able to persuade ourselves that vomiting had any adverse effect on the action of the drug as a curative agent, judged by the results obtained from microscopic examination of the fæces.

We have not found that this drug has any deleterious action on the heart. In no case was there any sign of dilatation after the course was finished, although many of the cases were up all day during practically the whole course of treatment.

As indicated above our method of administration enabled us to give patients such diet as their physical condition demanded or allowed, and a number of the cases were on ordinary diet almost from the beginning of treatment.

We have now had patients under treatment on every variety of diet and we believe that such diet may be given as seems appropriate to each individual case, judged from a clinical point of view.

In only one case was the drug discontinued on account of vomiting. This case had relapsed after his first course of treatment, during which he had not more than the average amount of sickness. He was then given emetine hydrochloride one grain hypodermically in the forenoon and two grains of the emetine bismuth iodide at night. Vomiting became so acute and so continuous that all medicine was stopped after twelve grains of the emetine bismuth iodide had been taken.

In another place the results of the treatment of the two classes are given and these speak for themselves. We wish, however, to draw attention to one detail which our results show in the treatment of acute cases. Of the four cases which we class as "cured," three had never had any previous emetine treatment. We do not wish to draw any rash conclusion from so small a number of cases, but we would suggest that some trial of this drug might be made in early cases of the acute disease. Two of these three cases had their first symptom of dysentery less than six months previous to treatment; the other had an attack in November, 1915, in Gallipoli fifteen months ago, but there is no evidence to show whether this was bacillary or amœbic dysentery. Leaving this attack aside, his dysenteric history was all within the six months previous to treatment here.

In the second class of case, the uncured cases, the drug seems to merit to a great extent the claims that have been put forward in its favour. Yet in this class we have had a few failures.

The more we see of amœbic dysentery the stronger becomes our belief that the successful treatment of the condition depends on the thorough regularity and persistence of appropriate treatment in the very earliest stages of the disease.

If a case is not cured in its earliest stages it seems almost inevitable that it will become an uncured carrier. In this condition the patient is a danger to his neighbours and is himself liable to relapses of a more or less acute nature which will at the very least interfere with his life as a useful fighting man.

The observation of the cases under our care has led us to the following conclusion regarding the general treatment of amœbic dysentery.

(1) The necessity of repeated examination of the stools with a view first of all to accurate diagnosis. Two negative examinations

are not nearly sufficient. We have had cases where the history and clinical signs pointed strongly to this disease and where only after four or five examinations was the *E. histolytica* found.

(2) That the basis of all treatment in the beginning of an acute case should be a minimum total of twelve grains emetine hydrochloride administered hypodermically; but that no one should consider this treatment necessarily sufficient by itself.

(3) That ipecacuanha in some form should be administered by the mouth along with or following the hypodermic treatment.

(4) That when treatment is concluded the repeated examination of stools is necessary to gauge the effect of the treatment, and that the oftener the stools are examined the more accurate will be the results obtained.

TABLE II.—Treatment with Hypodermic Injections of Emetine Hydrochloride.—Nineteen Cases.

Case No.	Emetine hydrochloride injections, 1 grain daily—12 grains	Last positive examinations	Relapsed	Number of negative examinations	Number of days negative
	(A) Cyst Carrier Cases.				
1	Sept. 12—Sept. 23, 1916 ..	Sept. 19	—	46	46
2*	,, 11— ,, 22, ,, ..	,, 22	Oct. 1	—	—
3	,, 12— ,, 23, ,, ..	,, 16	—	35	37
4*	,, 16—19; Sept. 23—30, 1916	—	No reaction	—	—
5	,, 18—Sept. 29, 1916 ..	Sept. 30	—	12	23
6	,, 18— ,, 29, ,, ..	—	No reaction	—	See Table V
7	,, 20—Oct. 1, ,, ..	Sept. 27	Oct. 2	—	,, ,,
8	,, 25— ,, 6, ,, ..	,, 26	—	24	38
9	,, 25— ,, 6, ,, ..	Oct. 5	Oct. 19	—	See Table V
10*	,, 24—Sept. 30, ,, (7 gr.)	—	No reaction	—	—
11*	,, 25—Oct. 1, ,, (7 gr.)	Sept. 30	Oct. 5	11	11
12	,, 30— ,, 15, ,, (½ gr. to 1 gr. daily, 12 gr.)	Oct. 5	—	11	21
13	Oct. 7—Oct. 18, 1916 ..	,, 5	—	22	26
14	,, 29—Nov. 9, ,, ..	Nov. 5	—	50	50
15	Nov. 15— ,, 26, ,, ..	,, 20	Dec. 6	—	See Table V
16	,, 18— ,, 29, ,, ..	,, 23	—	17	22
	(B) Acute Cases.				
17	Sept. 17—Sept. 28, 1916 ..	Sept. 24	—	32	36
18	Oct. 2—Oct. 13 ,, ..	Oct. 13	Oct. 18 (cysts)	—	See Table V
19	Nov. 11—Nov. 22 ,, ..	Nov. 19	Nov. 27 (amœbæ)	—	—

* Cases 2, 4, 10 and 11 were military prisoners.

In this connexion we suggest that in acute cases their physical condition will rarely, if ever, permit of their discharge within a period of six weeks from the beginning of treatment, and that therefore a stool should be examined as often as circumstances permit.

Thus they will be under close observation for three weeks after the cessation of treatment and in our experience relapses in this period are most common in the third and fourth weeks.

As regards uncured "carrier" cases, their condition may allow of their discharge to convalescent camp or some form of duty, and we suggest that if this is done each case should be readmitted to hospital for daily routine examination during his fourth week after cessation of treatment. These cases will most likely be of more use in Europe than in a climate where dysentery is endemic, and should therefore be sent home.

TABLE III.—TREATMENT WITH EMETINE HYDROCHLORIDE INJECTIONS AND PULVERIZED IPECACUANHA. SEVEN CASES.

Case No.	Emetine hydrochloride 1-gr. injections and pulverized ipecacuanha gr. v daily	Last positive examinations	Number of negative examinations	Number of days negative
	Cyst Carrier Cases.			
20	Emetine : Oct. 11—Oct. 22, 12 gr. P.I. : Oct. 12—Nov. 4, 120 ,,	Oct. 13	32	33
21	Emetine : Oct. 10—Oct. 21, 12 ,, P.I. : Oct. 13—Oct. 28, 80 ,,	Oct. 14	31	32
22	Emetine : Oct. 15—Oct. 26, 12 ,, P.I. : Oct. 15—Nov. 1, 90 ,,	Oct. 23	24	29
23	Emetine : Oct. 29—Nov. 9, 12 ,, P.I. : Nov. 1—Nov. 15, 75 ,,	Nov. 5	40	41
24	Emetine / P.I. Nov. 30—Dec. 11 12 ,, / 60 ,,	Dec. 8	30	34
25	Emetine / P.I. Nov. 30—Dec. 11 12 ,, / 60 ,,	Nov. 30	Relapsed, Dec. 14	See Table V.
	Acute Cases.			
26	Emetine : Nov. 2—Nov. 13, 12 gr. P.I. : Nov. 2—Nov. 15, 70 ,,	Nov. 5	37	38

TABLE IV.—TREATMENT WITH EMETINE HYDROCHLORIDE ONE GRAIN HYPODERMICALLY AND HALF GRAIN ORALLY. FOUR CASES.

Case No.	Emetine hydrochloride 1-gr. injection and ½ gr. orally, daily	Last positive examinations	Number of negative examinations	Number of days negative
	Cyst Carrier Cases.			
27	Injections : Dec. 9—Dec. 20, 12 gr. Orally : Dec. 16—Dec. 22, 3½ ,,	Dec. 16	36	37
28	Do. : Dec. 14—Dec. 25 12 ,, / 6 ,,	Dec. 13	41	43
29	Do. : Dec. 17—Dec. 28 12 ,, / 6 ,,	Dec. 18	38	41
	Acute Cases.			
30	Injections : Dec. 9—Dec. 20, 12 gr. Orally : Dec. 16—Dec. 28, 6½ ,,	Dec. 20	40	40

TABLE V.—TREATMENT WITH EMETINE BISMUTH IODIDE: THIRTY-THREE CASES.

Case No.	Previous attack of dysentery	Previous emetine treatment	Emetine bismuth iodide gr. ii—iii daily	Last positive examination	Relapsed	Number of negative examinations	Number of days negative
			(A) *Cyst Carrier Cases.*				
6	Suez, Aug., 1916	12 gr., see Table II..	Oct. 25—Nov. 11 (gr. i—ii) .. 30 gr.	Nov. 3	..	37	37
7	Africa years ago	12 ,, see Table II..	Oct. 25—Nov. 11 (gr. i—ii) .. 30 ,,	Oct. 30	..	42	42
9	None	12 ,, see Table II..	Oct. 28—Nov. 13 (gr. i—ii) .. 30 ,,	Oct. 28	..	47	47
15	Bacillary	12 ,, see Table II..	Dec. 20—Jan. 4, 1917 (gr. ii) .. 30 ,,	Dec. 21	..	43	46
25	None	12 ,, see Table III..	Dec. 28—Jan. 11, 1917 (gr. ii—iii) 36 ,,	Dec. 29	..	46	46
31	Mudros, Nov., 1915; Mesopotamia, 1916	60 injections	Nov. 27—Dec. 12 (gr. ii) .. 30 ,,	Nov. 28	Dec. 21	See Tables VI, VII	21
32	Mesopotamia, March, 1916	15 injections	Dec. 11—Dec. 26 (gr. ii) .. 30 ,,	Dec. 14	..	37	42
33	None	None	Dec. 16—Dec. 30 (gr. ii) .. 30 ,,	Dec. 19	..	43	43
34	Gallipoli, Oct., 1915; Canal zone, Oct., 1916	18 injections	Dec. 16—Dec. 31 (gr. ii) .. 30 ,,	Dec. 18	..	44	44
35	Mesopotamia, June, 1916	None	Dec. 21—Jan. 7, 1917 (gr. ii.—iii) 36 ,,	Dec. 24	..	52	58
36	None	None	Dec. 28—Jan. 11, 1917 (gr. ii—iii) 36 ,,	Dec. 30	..	44	44
37	None	None	Jan. 25, 1917—Feb. 5 (gr. iii) .. 36 ,,	Jan. 28	..	32	41
38	Mesopotamia, Sept., 1916	2 injections	Jan. 24—Feb. 4 (gr. iii) .. 36 ,,	Jan. 26	..	37	39
39	Gallipoli, Nov., 1915; Mesopotamia, July and Oct., 1916	16 injections	Jan. 23—Feb. 3 (gr. iii) .. 36 ,,	Jan. 25	..	40	40
40	Mesopotamia, Oct., 1916	12 injections	Jan. 24—Feb. 4 (gr. iii) .. 36 ,,	Jan. 26	..	38	39
41	Gallipoli, Aug., 1915; Salonica, Nov., 1915; Mesopotamia, Aug., 1916	60—70 injections ..	Jan. 26—Feb. 6 (gr. iii) .. 36 ,,	..	No reaction	See Table VII	..
42	India, 1910; Gallipoli, Nov., 1915; Mesopotamia, Oct., 1916	About 70 injections ..	Jan. 26—Feb. 6 (gr. iii) .. 36 ,,	..	No reaction	U. T.	..
			(B) *Acute Cases.*				
18	None	12 injections, see table	Oct. 28—Nov. 13 (gr. i—ii) .. 30 gr.	Nov. 4	Nov. 23 (cysts)	See Table VI	18
43	Salonica, 1915; Salonica, March, 1916; Salonica, Nov., 1916	None	Dec. 12—Dec. 24 (gr. ii) .. 26 ,,	Dec. 15	..	39	40
44	Canal zone, Oct., 1916 ..	28 injections	Dec. 16—Dec. 30 (gr. ii) .. 30 ,,	Dec. 25	Jan. 27 (amœbæ)	See Table VII	30
45	Gallipoli, 1915	26 injections	Dec. 27—Jan. 11 (gr. ii—iii) .. 38 ,,	Jan. 5	Feb. 5 (amœbæ)	See Table VII	30

46	Egypt, Aug., 1916 ..	None	Dec. 28—Jan. 11 (gr. ii—iii) ..	36 gr.	Jan. 4	..	39	40
47	India, March, 1915 ..	None	Dec. 30—Jan. 10 (gr. iii) ..	36 ,,	Dec. 31	Jan. 20 (cysts)	See Table VII	19
48	None	None	Jan. 1—Jan. 13 (gr. ii—iii) ..	37 ,,	Jan. 5	Jan. 20 (cysts)	See Table VII	14
49	S. Africa, 1900; Mesopotamia, 1916	Two courses	Jan. 3—Jan. 14 (gr. iii) ..	36 ,,	Jan. 7	..	43	44
50	Salonica, Oct. 1916, ? bacillary	None	Jan. 5—Jan. 16 (gr. iii) ..	36 ,,	Jan. 12	..	36	36
51	Kantara, Aug., 1916 ..	2 injections	Jan. 5—Jan. 16 (gr. iii) ..	36 ,,	Jan. 6	..	41	42
52	Gallipoli, 1915; Canal zone, 1916	One course	Jan. 5—Jan. 16 (gr. iii) ..	36 ,,	Jan. 7	Jan. 24 (cysts)	See Table VII	16
53	India, May, 1916 ..	Two courses	Jan. 8—Jan. 19 (gr. iii) ..	36 ,,	..	No reaction	See Table VI	..
54	Port Said, 1915; Alexandria, 1916	12 injections	Jan. 13—Jan. 24 (gr. iii) ..	36 ,,	Jan. 14	..	40	41
55	Assiout, July, 1916; Assouan, Oct., 1916	43 injections	Jan. 22—Feb. 2 (gr. iii) ..	36 ,,	..	No reaction	See Table VII	..
56	Salonica, Oct., 1916	24 injections	Jan. 26—Feb. 6 (gr. iii) ..	36 ,,	Jan. 26	..	30	31
57	Salonica, Dec., 1915; Sept., 1916; Nov., 1916	18 injections	Jan. 26—Feb. 6 (gr. iii) ..	36 ,,	Feb. 3	..	55	56

TABLE VI.—TREATMENT WITH EMETINE BISMUTH IODIDE, SECOND COURSE: THREE CASES.

Case No.	Previous emetine treatment	Emetine bismuth iodide, gr. iii daily	Last positive examination	Relapsed	Number of negative examinations	Number of days negative
		(A) *Cyst Carrier Cases.*				
31	See Table V ..	Dec. 31—Jan. 11 (gr. iii), 36 gr.	Jan. 1	Jan. 23	See Table VII	..
		(B) *Acute Cases.*				
18	See Table V ..	Dec. 31—Jan. 11 (gr. iii), 36 gr.	Dec. 31	Jan. 17	..	H. S.
53	See Table V ..	Jan. 20—Jan. 31 (gr. iii), 36 ,, ...	Feb. 5	..	26	26

TABLE VII.—Treatment with Emetine Hydrochloride Injections and Emetine Bismuth Iodide. Ten Cases.

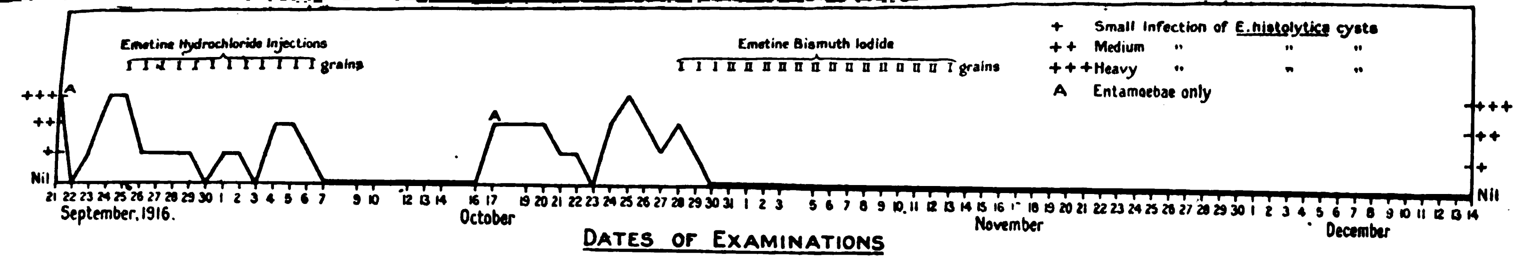
Case No.	Previous attack of dysentery	Previous emetine treatment	Emetine bismuth iodide gr. i–ii emetine hydrochloride injections gr. vii	Last positive examination	Relapsed	Number of negative examinations	Number of days negative
			(A) *Cyst Carrier Cases*				
31	See Table V and VII	—	Feb. 5—Feb. 16	Feb. 8	Feb. 24	U.T.	15
41	See Table V	—	Feb. 12—Feb. 23	Feb. 14	—	37	37
			(B) *Acute Cases.*				
44	See Table V	—	Jan. 29—Feb. 9	Jan. 27	Mar. 4	U.T.	35
45	See Table V	—	Feb. 12—Feb. 23	Feb. 22	Mar. 4	U.T.	9
47	See Table V	—	Jan. 22—Feb. 2	Jan. 29	Feb. 9	—	H.S.
48	See Table V	—	Jan. 22—Jan. 29	Jan. 24	—	40	41
52	See Table V	—	Jan. 26—Feb. 6	Feb. 9	Feb. 25	U.T.	—
55	See Table V	—	Feb. 12—Feb. 23	Feb. 14	Feb. 27	U.T.	—
58	Mudros, 1915, Alexandria, June, 1916	4 injections,	Jan. 22—Feb. 1	Jan. 26	—	37	39
59	Canal zone, Nov., 1916	8 injections 30 tabloids	Feb. 7—Feb. 18	Feb. 12	Feb. 25	U.T.	12

U.T. = Under treatment.
H.S. = Discharged to Hospital Ship.

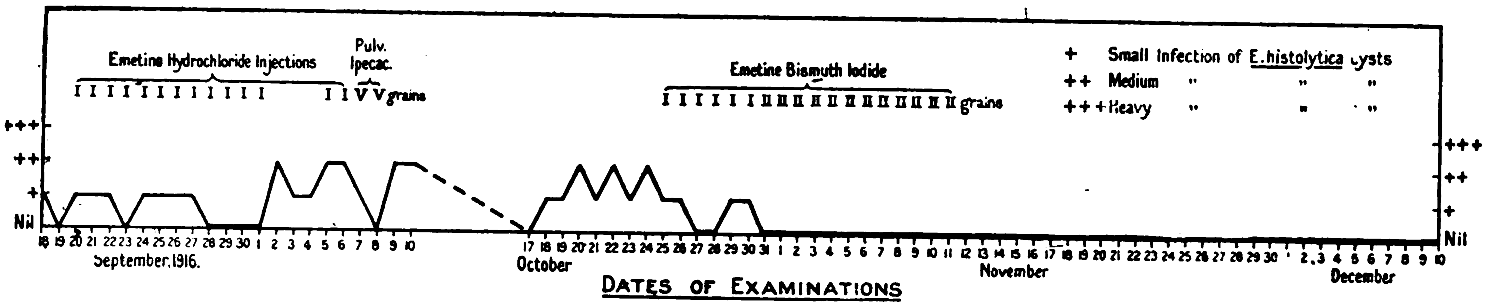
APPENDIX ON THE PROTOZOOLOGICAL EXAMINATION OF THE STOOL OF 1,088 CASES.

From July 30, 1916, to February 28, 1917, the stools of 1,088 cases have been examined for intestinal parasites; 5,350 stools were examined in all; 705 cases were only examined once, 148 were examined twice, and the remaining 235 were examined three or more times ; the average number of examinations per case for the latter series was 18·9. Practically all the cases examined were patients who were suffering from dysentery or diarrhœa; 30·3 per cent passed blood and mucus stools, 38·6 per cent had some intestinal parasites present, and 38·8 per cent had neither parasites nor blood and mucus.

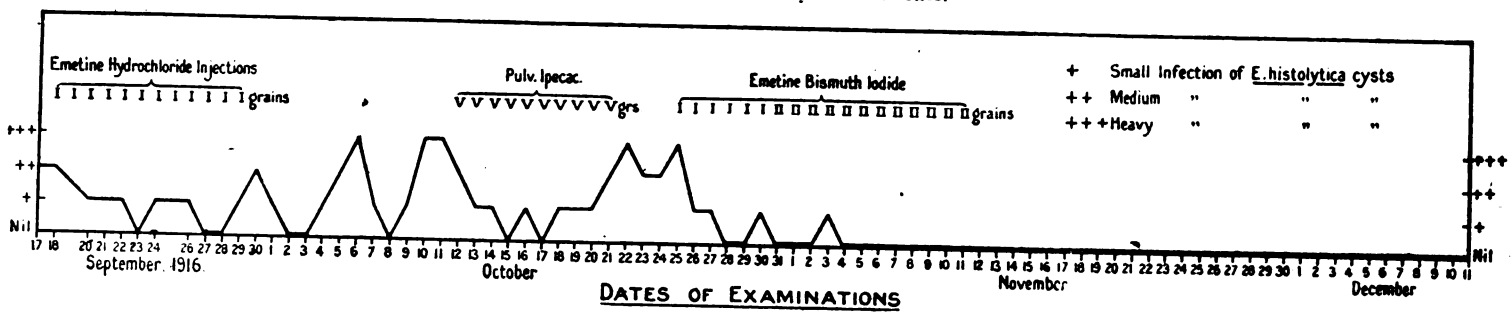
Four hundred and twenty cases had some intestinal protozoa or worm eggs present; 62·2 per cent of these were pure infections, 22·1 per cent were double infections, 11·2 per cent were triple infections and 4·5 per cent had four or more different parasites present.



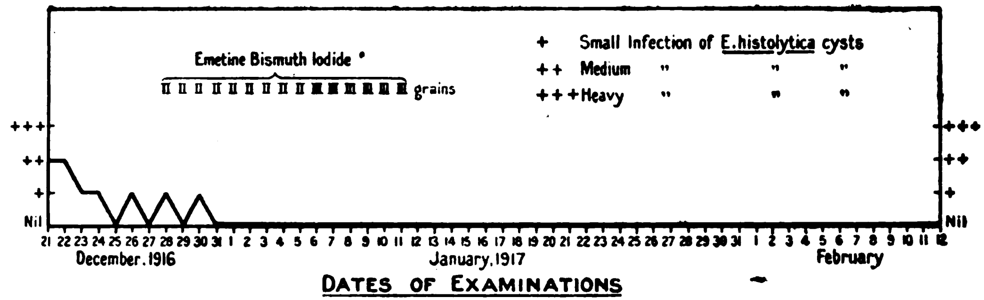
CASE 9. DIAGRAM 2.—Cyst carrier case.



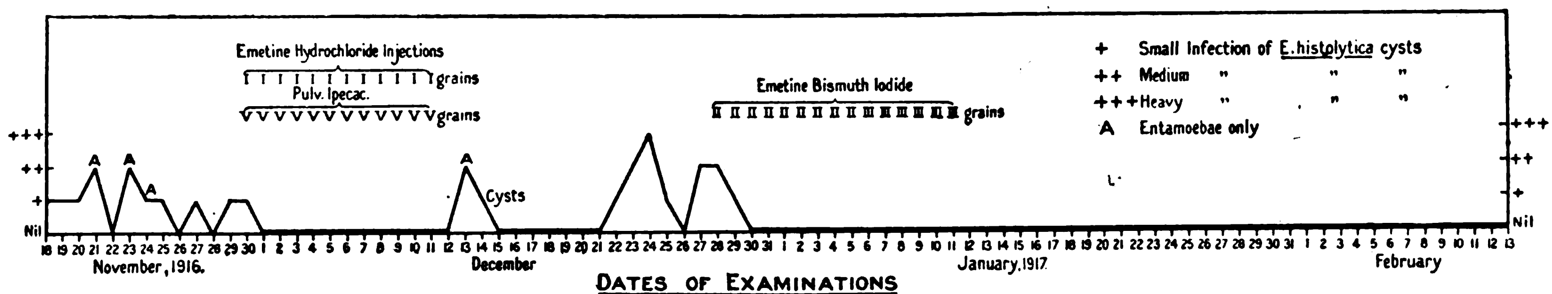
CASE 7. DIAGRAM 3.—Cyst carrier case.



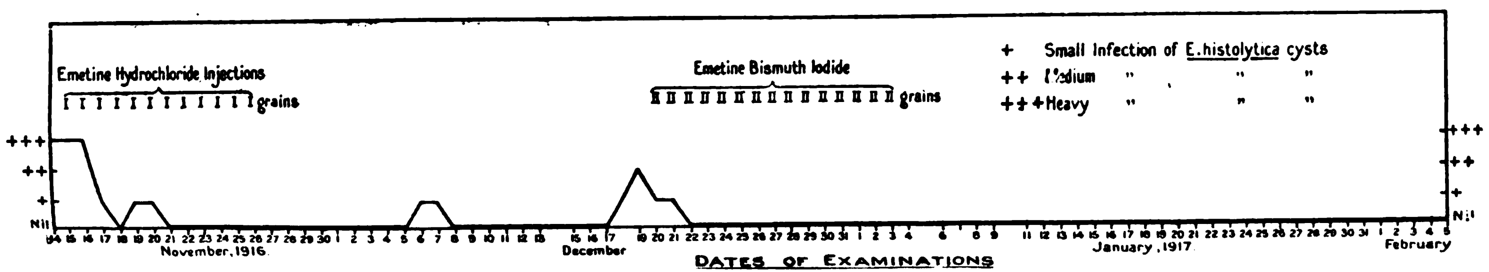
CASE 6. DIAGRAM 4.—Cyst carrier case.

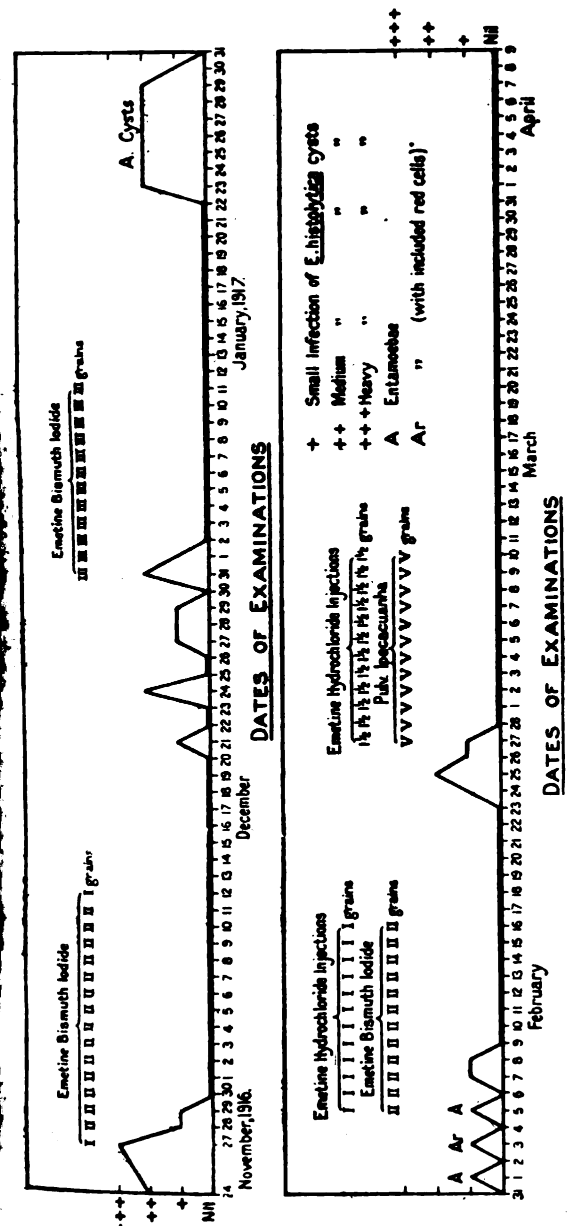


CASE 36. DIAGRAM 5.—Cyst carrier case.

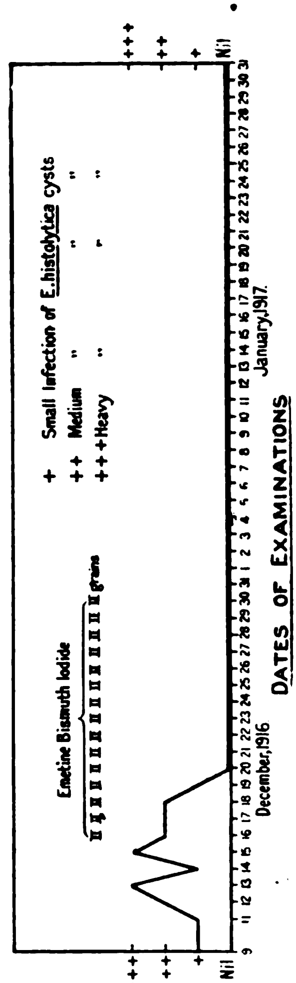


CASE 25. DIAGRAM 6.—Cyst carrier case.

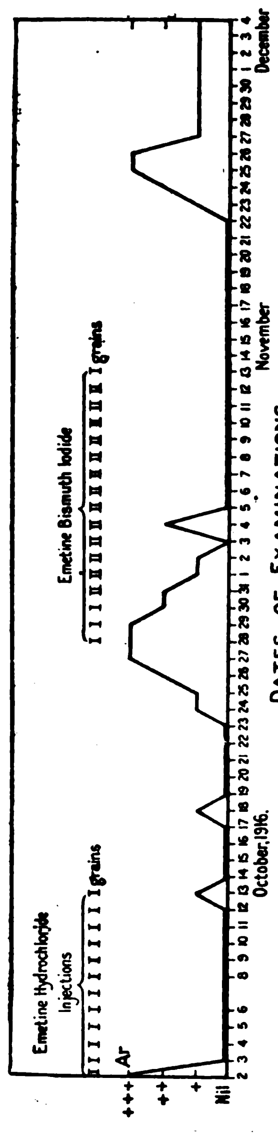


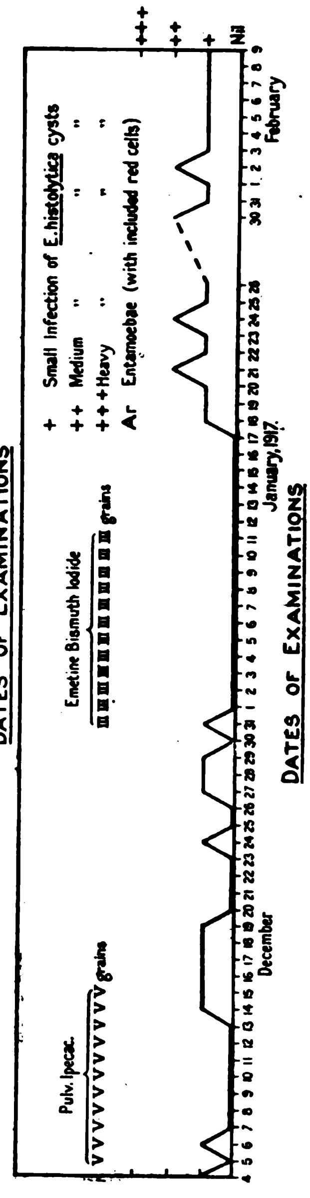


CASE 31. DIAGRAM 8.—Cyst carrier case.

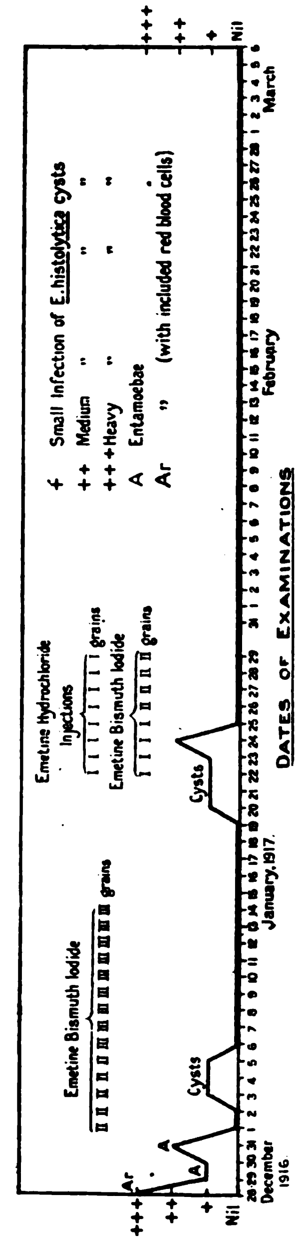


CASE 33. DIAGRAM 9.—Cyst carrier case.





CASE 18. DIAGRAM 10.—Acute case.



CASE 48. DIAGRAM 11.—Acute case.

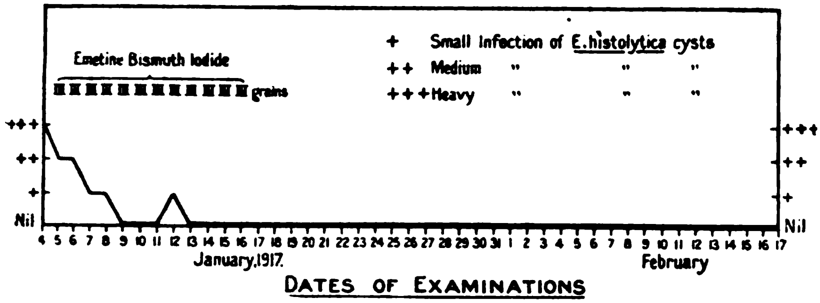


DIAGRAM 12.—Acute case.

APPENDIX TABLE I.—TOTAL RESULTS OF PROTOZOOLOGICAL EXAMINATIONS OF 1,088 CASES.

	No.	Per cent
No parasites or blood and mucus present	422	38·8
Blood and mucus present	351	32·3
E. histolytica	85	7·8
E. coli	172	15·8
Giardia (Lamblia) intestinalis	140	12·9
Chilomastix (Tetramitus) mesnili	100	9·2
Trichomonas intestinalis	68	6·2
Entamœba nana	24	2·2
Entamœbæ (undiagnosed)	41	3·8
Coccidium isospora	6	0·6
"Iodine" cysts	10	0·9
Trichuris trichiura (eggs)	24	2·2
Ascaris lumbricoides (eggs)	2	0·2
Ankylostomum duodenale	1	0·1

E. histolytica was present in 7·8 per cent of the total cases examined: 26·9 per cent of these were acute cases and 73·1 per cent were cyst carriers. The total number of these cases was eighty-five, of which some had to be invalided home, some were not patients in this hospital and fifty-nine were given emetine treatment here as described in the first part of this report. The percentage of cases in which *E. histolytica* were found is smaller than that obtained in England, but there are two factors which tend to make it so. One is the large number of cases of bacillary dysentery which were passing nothing but blood and mucus in their stools at the time they were examined; no parasites were found in these unless there was some fæcal matter admixed with the mucus. As these cases were usually examined once or twice only, very few parasites were found in them. In England very few such cases

were met with. The other factor is, that during the summer, diarrhœa is much more prevalent here than in England and a large number of such cases had no protozoal parasites in their stools.

In Appendix Table II the results have been arranged for each month.

APPENDIX TABLE II.—MONTHLY RESULTS, JULY 30, 1916, TO FEBRUARY 28, 1917.

	JULY 30 TO AUGUST 31		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Nil	118	46·1	60	36·6	65	44·2	83	39·3	56	31·6	26	28·0	14	35·0
Blood and mucus	59	23·1	54	33·7	44	29·9	74	35·1	67	37·9	34	36·6	19	47·5
E. histolytica ..	12	4·7	13	7·9	12	8·2	10	4·7	15	8·5	18	19·4	5	12·5
E. coli	41	16·0	30	18·3	19	12·9	25	11·9	32	18·1	18	19·4	7	17·5
Giardia (Lamblia)	34	13·3	20	12·2	20	13·6	20	9·5	26	14·7	12	12·9	8	20·0
Chilomastix (Tetramitus)	27	10·1	28	17·1	12	8·2	12	5·7	9	5·1	12	12·9	—	—
Trichomonas ..	17	6·6	9	5·5	8	5·4	17	8·1	6	3·4	10	10·8	1	2·5
Entamœbæ (undiagnosed)	10	3·9	8	4·9	5	3·4	11	5·2	5	2·8	2	2·2	—	—
E. nana	2	0·8	6	3·7	—	—	5	2·4	4	2·3	4	4·3	3	7·5
Coccidium isospora	—	—	2	1·2	—	—	2	0·9	2	1·1	—	—	—	—
"Iodine" cysts ..	2	0·8	3	1·8	—	—	3	1·4	—	—	2	2·2	—	—
Trichuris (eggs) ..	2	0·8	3	1·8	2	1·4	6	2·8	5	2·8	3	3·2	3	7·5
Ascaris (eggs) ..	—	—	1	0·6	—	—	—	—	1	0·6	—	—	—	—
Ankylostomum ..	—	—	1	0·6	—	—	—	—	—	—	—	—	—	—
Total cases ..	256	—	164	—	147	—	211	—	177	—	93	—	40	—

It will be observed that there was no striking variability from month to month in the percentages of the intestinal parasites other than *E. histolytica* (except Tetramitus for September, see below). The percentage of *E. histolytica* infections for January and February was much higher than for the other months. This was due to a comparatively large increase in the number of acute cases, as shown in the following table :—

APPENDIX TABLE III.

	August Per cent	September Per cent	October Per cent	November Per cent	December Per cent	January Per cent	February Per cent
Acute amœbics ..	0·4	0·0	1·4	0·5	3·4	10·8	7·5
Cyst carriers ..	4·3	7·9	6·8	4·2	5·1	8·6	5·0

The percentages are of the total cases examined.

The number of cases passing blood and mucus varied from 23·1 per cent to 47·5 per cent. Deducting from these the cases which were found to be acute amœbic dysentery the following monthly percentages are obtained:—

August Per cent	September Per cent	October Per cent	November Per cent	December Per cent	January Per cent	February Per cent
22·7	33·7	28·5	34·6	34·5	25·8	40·0

Most of these cases were bacillary dysentery of some form or other, so that it will be seen that for no particular month or months during the period dealt with could bacillary dysentery be said to be more prevalent than in the others.

Table IV has been compiled to show the increase in the findings of the commoner parasites when the stool of a patient is examined more than once.

The most striking results are those of cases examined more than three times. For instance, of the 177 cases under this heading (which includes almost all the cases of *E. histolytica* infection) 27·1 per cent were found to have *E. histolytica* when first examined; this was increased to 41·2 per cent when the stools were examined three times. The *E. coli* infections were increased in like manner from 15·3 per cent to 24·9 per cent.

Parasites other than Entamœba histolytica.

Entamœba nana, the intestinal parasite discovered by Lieutenant-Colonel Wenyon, R.A.M.C., last year, was found in twenty-four cases, in none of which did it appear to be at all pathogenic.

Coccidium isospora was found in six cases. Five were patients in this hospital, and all were dysentery cases. Two were acute amœbics, two were bacillary and one was a chronic amœbic. The two acute amœbics were given both emetine hydrochloride and emetine bismuth iodide for their amœbic infections, but neither emetine compound had any effect upon the coccidium. One case was specially treated for the coccidial infection; he was given one-grain injections of emetine hydrochloride daily for four days, and again five days later for nine days (thirteen grains in all). The infection was practically unaffected. Silver nitrate injections, 1 in 2,000, one pint were given for eight days. The coccidia disappeared after three days of treatment, and were only found on one occasion subsequently (four days after the last silver nitrate injection). The stool was free of infection for sixteen days (daily examinations).

APPENDIX TABLE IV.

	First Examination of all Cases		Cases Examined Twice or more				Cases Examined Three Times or more						Cases Examined Four Times or more					
			First examination		First and second		First examination		First and second		First, second and third		First examination		First three		Four and more	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
No parasites	459	42·2	127	33·2	83	21·7	67	28·4	40	16·9	31	13·1	40	22·6	16	9·0	11	6·2
E. histolytica	55	5·1	50	13·1	66	17·2	48	20·3	65	27·5	74	31·4	48	27·1	73	41·2	80	45·2
E. coli	101	9·3	48	12·5	71	18·5	32	13·6	46	19·5	60	25·4	27	15·3	44	24·9	78	44·1
Giardia (Lamblia) ..	109	10·0	39	10·2	47	12·3	28	11·9	33	14·0	36	15·3	25	14·1	27	15·3	46	26·0
Chilomastix (Tetramitus)..	59	5·4	23	6·0	35	9·1	15	6·4	24	10·2	33	14·0	13	7·3	22	12·4	43	24·3
Trichomonas	46	4·2	17	4·4	26	6·8	13	5·5	16	6·8	20	8·5	14	7·9	16	9·0	28	15·8
Total number of cases—1,088			383		383		236		236		236		177		177		177	

In all the other cases except one the coccidia disappeared from the stools without special treatment.

Lamblia infections did not appear to cause much inconvenience to the patient in most cases. Six cases, however, passed stools which consisted of practically nothing but greenish-black mucus, embedded in which were enormous numbers of the free forms of the flagellate. One patient passed three such stools in thirteen days. Several cases passed very large numbers of Lamblia cysts, which were also embedded in mucus.

Similar stools containing trichomonas (two cases), and tetramitus (one case), were also seen.

In none of these cases was there any blood or cellular exudate present.

Trichomonas when present in large numbers invariably occurred in liquid stools, and appeared to be the cause of diarrhœa in such cases.

Blastocystis was also found in liquid stools in enormous numbers when no other intestinal parasite was found.

One interesting case of the spread of an infection took place during September, 1916. A glance at Table II will show that the percentage of tetramitus infections for September is much higher than for any other month. This is accounted for by the fact that practically every case admitted into the amœbic dysentery ward sooner or later became infected with this parasite. When the patients were moved to a different ward (September 29) the percentage fell immediately.

One case of ankylostome infection was found. The patient was a coal-miner previous to the War. He was on Gallipoli during the winter of 1915, and was engaged in mining operations there. He was frequently working with his feet in water and wore no socks, and had only rope slippers on his feet. He was successfully treated by thymol, the adult worms being found in the stools after several doses.

THE DIAGNOSTIC INTERPRETATION OF THE AGGLUTINATION TEST IN TYPHOID AND PARATYPHOID INFECTIONS OCCURRING AMONG TYPHOID VACCINATED TROOPS.

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AND

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Royal Army Medical Corps.
(From the Central Bacteriological Laboratory, Alexandria, of the M.E.F. and E.E.F.)

It is a matter of common interest amongst those working in military laboratories that, since the introduction of antityphoid inoculation in the Army, the interpretation, in diagnostic terms, of results obtained by the agglutination test has become much more difficult than in pre-inoculation days. This fact, with which our previous experience had made us familiar, has recently been emphasized during an extensive series of observations carried out by us on cases of enterica which occurred in the Mediterranean Expeditionary Force. The results obtained by the agglutination method were controlled by actual isolation of a definite organism of the enterica group in as many as possible of the total number of cases examined.

As a result of these examinations we feel we are in a position to state that, although the agglutination test in inoculated persons suffering from an enterica-like illness at varying intervals after inoculation must now be interpreted in the light of new standards, the method, as an indicator of the correct diagnosis, still possesses very distinct value. The utility of the reaction in differentiating between infections due to *Bacillus paratyphosus* A or B in persons inoculated with *B. typhosus* vaccine only depends, of course, on the degree of specificity of the agglutinating substances which appear in the serum as a result of infection with either organism.

As might have been anticipated in a force till recently protected against *B. typhosus* only, the enterica infections which actually occurred were due, in an overwhelming majority of the total number of cases, to one or other of the paratyphoid organisms. But, even amongst the relatively small number of proved *B. typhosus* infec-

tions which were met with, the data obtained by the agglutination method were found to be of very important significance as an aid to diagnosis.

The measure of value to be attached to the agglutination method in persons inoculated with the typhoid mono-vaccine at present varies with the experience of the individual observer, whilst the practical utility of the test in persons who have received the triple enteric vaccine is still a matter of conjecture. We have therefore thought it desirable to place on record the various types of agglutination reactions observed by us in cases of enterica arising amongst troops inoculated with *B. typhosus*, and, at the same time, to discuss the manner in which inferences (likely to be correct for the great majority of cases examined by this method) may be reached.

Technique.

The macroscopic method was exclusively employed and emulsion of the living organisms we consider are to be preferred as being distinctly more sensitive to agglutinin influence.

In practice, test-tubes, three inches in length by $\frac{1}{8}$ inch, were found most convenient for the observations, and the bacillary emulsions (in 0·85 per cent saline solution) were freshly prepared from twenty-four hours' agar slope growths. We prefer to use an emulsion the opalescence of which is as nearly as possible similar to that of 0·1 per cent suspension of very finely powdered pure chalk in distilled water.

The strains of the typhoidal bacilli were those specially selected in the Central Laboratory, Cairo, for use in the various laboratories of the Mediterranean Expeditionary Force. A preliminary observation was made first of all with a 1 in 50 dilution of the serum against the three organisms to determine the presence of any specific agglutinins. The degree of agglutinating power was afterwards determined by testing progressive dilutions of the serum, the series of dilutions being as follows :—

1 in 50 1 in 100 1 in 200 1 in 500 1 in 1,000 1 in 2,000.

Higher dilutions in multiples of two (1 in 4,000, 8,000, etc.) were investigated in the case of a certain powerfully agglutinating area. These dilutions were obtained by placing in a series of test tubes a fixed quantity (usually 0·4 cubic centimetre) of the serum diluted as follows :—

1 in 25 1 in 50 1 in 100 1 in 250 1 in 500 1 in 1,000

and then adding an equal volume of the bacillary emulsion. All

tubes were incubated for two hours at 37° C. They were then removed from the incubator and allowed to stand at room temperature till next day. Readings were taken at two hours, and finally at twenty-four hours.

RESULTS OBTAINED IN CASES OF PARATYPHOID INFECTION ARISING IN MEN INOCULATED WITH *B. typhosus* VACCINE.

It may at once be stated that the great majority of these cases provided unmistakeable evidence of a specific agglutinative response to one or other of the paratyphoid organisms. In practically every case there was, of course, a definite degree of agglutination with *B. typhosus* also. This was frequently equal to that obtained with one of the paratyphoid organisms. In most cases, however, the *B. typhosus* agglutinins on titration of the serum to the vanishing point of the reaction, were found to be of distinctly lower grade, although in a few instances the typhoid agglutination titre was found to be actually higher than that obtained for the (infecting) paratyphoid organism.

Tables Nos. I, II, III and IV show typical examples of these results. In Table No. I the highest titre of the paratyphoid A agglutinins is 1 in 2,000; that of the concomitant typhoid agglutinins, 1 in 1,000. After two hours there was no reaction to *B. paratyphosus* B. Table II shows an analogous effect in a case of paratyphoid B infection. Table III a more marked reaction of the serum to *B. typhosus* than that to the infecting organism is shown, and in Table IV reactions equal in degree to both organisms.

TABLE I.

	Serum dilutions						
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000	1 : 2,000	Control
B. typhosus ..	++++	++++	++++	+++	+	–	–
B. para A ..	++++	++++	++++	++++	+++	+	–
B. para B ..	–	–	–	–	–	–	–

Reading after two hours at 37° C. *B. para* A isolated. Inoculation $\frac{T}{2}$ eight months previously. Agglutination test on seventh day of illness.

In this and in all subsequent tables the degree of reaction is signified by the number of + marks. ++++ corresponding to complete agglutination.

TABLE II.

	Serum dilutions							
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000	1 : 2,000	1 : 4,000	Control
B. typhosus	++++	++++	+++	++	+	–	–	–
B. para A ..	–	–	–	–	–	–	–	–
B. para B ..	++++	++++	++++	++++	++++	++	++	–

Reading after two hours at 37° C. Inoculation $\frac{T}{2}$ fifteen months previously. Test on fourteenth day of illness.

TABLE III.

	Serum dilutions					
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000	1 : 2,000
B. typhosus ..	++++	++++	++++	+++	++	–
B. para A ..	++++	++++	+++	–	–	–
B. para B ..	+	–	–	–	–	–

Reading after two hours at 37° C. Inoculated ten months previously. Test on twenty-first day of illness. *B. para* A isolated from fæces.

TABLE IV.

	Serum dilutions			
	1 : 50	1 : 100	1 : 200	1 : 500
B. typhosus ..	++++	++++	+++	–
B. para A ..	++++	++++	+++	–
B. para B ..	–	–	–	–

Reading after two hours at 37° C. Inoculated one year previously. Test in third week of illness. *B. para* A isolated from fæces.

TABLE V.—Original Agglutination Test.

Reading after two hours at 37° C.

	Dilutions of serum				
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000
B. typhosus ..	++++	++++	++++	+++	–
B. para A ..	–	–	–	–	–
B. para B ..	++++	++++	++++	++++	++
	Serum absorbed with B. typhosus.				
B. typhosus ..	–	–	–	–	–
B. para A ..	–	–	–	–	–
B. para B ..	++++	++++	++++	+++	+
	Serum absorbed with B. paratyphosus B.				
B. typhosus ..	++++	++++	+++	++	–
B. para A ..	–	–	–	–	–
B. para B ..	–	–	–	–	–

Technique of Absorption Tests.

Four cubic centimetres of a 1:25 dilution of serum was divided into two equal parts. Two twenty-four hours' agar slope growths of *B. typhosus* were emulsified in one part, and two similar agar slopes of the particular paratyphoid organism in the other. The emulsions were incubated for three to four hours, at the end of which time the treated serum was separated by means of the centrifuge and carefully pipetted off from the bacillary sediment.

The usual series of dilutions was then made from each portion of the serum, and both were tested with *B. typhosus*, and also with the paratyphoid organism in question. The results obtained are seen in Table V; it is clearly shown that independent agglutinins to *B. typhosus* and *B. paratyphosus* B were present in the serum.

It is to be noted that the agglutination reaction in the paratyphoid infections was absolutely specific; thus, in the typical results of Tables I to IV, while the reaction to the infecting

organism was registered by titres as high as 1 in 2,000 and 1 in 4,000, even 1 in 50 dilutions of the same serum failed to produce any effect with the other paratyphoid bacillus. The question arose as to whether the *B. typhosus* effect was, or was not due to the co-agglutinins. Absorption tests were therefore carried out in a number of cases; these proved that the serum contained independent agglutinins to the respective organisms (*vide* Table V).

The double agglutination obtained in the first place with the serum is open to interpretation as follows: (1) The case is one of mixed infection with *B. typhosus* and *B. paratyphosus* B; or (2) the specific agglutinin for *B. typhosus*, which was still present in the serum as a result of vaccination with this organism, has been increased in amount or activity as a result of the intercurrent paratyphoid infection. In practically every case in which well developed agglutinins to the paratyphoid organisms were detected, a corresponding effect to *B. typhosus* was also observable. Indeed, the frequency with which a double agglutination result of this kind was encountered during our investigation makes the first hypothesis—which, in fact, is a rather rare occurrence—highly improbable. The second hypothesis is by far the more likely explanation.

Occasionally the agglutination test revealed the presence of specific agglutinins to one or other of the paratyphoid organisms only—no reaction whatever with *B. typhosus* being visible. Types of such results are illustrated in Table Nos. VI and VII.

TABLE VI.

	Dilutions of serum				
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000
B. typhosus ..	—	—	—	—	—
B. para A ..	++++	++++	++++	++	—
B. para B ..	—	—	—	—	—

Inoculated $\frac{T}{2}$ thirteen months previously. Test on tenth day of illness.

TABLE VII.

	Dilutions of serum				
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000
B. typhosus ..	—	—	—	—	—
B. para A ..	—	—	—	—	—
B. para B ..	++++	+++	+++	+++	—

Inoculated $\frac{T}{2}$ fourteen months previously. Test on tenth day of illness.

In two cases moderately high titre agglutinins to both *B. para* A and B were noted. Careful absorption tests were

carried out, the serum being saturated with *B. typhosus*, *B. para* A, and *B. para* B, and the "absorbed" sera tested each against these organisms. The results (*vide* Table VIII) showed the presence of independent agglutinins to all three typhoidal bacilli.

TABLE VIII.—ORIGINAL AGGLUTINATION TEST.
Reading after two hours.

	Dilutions of serum			
	1 : 50	1 : 100	1 : 200	1 : 500
B. typhosus ..	++++	++++	+	−
B. para A ..	++++	++++	++++	++
B. para B ..	++++	+++	++	+
	Serum after Absorption with B. typhosus.			
B. typhosus ..	−	−	−	−
B. para A ..	++++	++++	+++	+
B. para B ..	++++	+++	+	−
	Serum after Absorption with B. para *A.*			
B. typhosus ..	++++	++++	−	−
B. para A ..	−	−	−	−
B. para B ..	++++	+++	+	−
	Serum after Absorption with B. para *B.*			
B. typhosus ..	++++	+++	−	−
B. para A ..	++++	++++	+++	+
B. para B ..	−	−	−	−

Inoculated $\frac{T}{2}$ ten months previously. Test about fourteenth day of illness.

The conclusion drawn from such a finding in the absence of direct isolation of the infecting organisms was that the case represented a mixed *B. para* A and B infection.

Degree of Agglutination Reaction.

In a large number of cases the highest titres registered in the second and third weeks were not lower than 1 in 1,000 to the specific organism. The highest titre noted in *B. paratyphosus* A infections was 1 in 4,000; in *B. paratyphosus* B infections reactions in titres as high as 1 in 8,000 were obtained in some instances. In general the reactions to *B. paratyphosus* B were more pronounced than those to *B. paratyphosus* A.

N.B.—It has been concluded by some bacteriologists in the Mediterranean Expeditionary Force that the agglutinative response was in many cases too late a feature of the illness to be of value as a diagnostic sign. We have to record that high titre agglutinins in both *B. paratyphosus* A and *B. paratyphosus* B infections have been noted as early as the seventh day of the illness (*vide* Table I).

It is generally agreed that the reaction in paratyphoid A infections is often feeble. Not infrequently a *B. paratyphosus* A infection calls forth no agglutination response whatsoever. In many of our cases the *B. paratyphosus* A agglutinations were of relatively low potency (1 in 50 and 1 in 100 titres), and in certain cases in which *B. paratyphosus* A was isolated no specific agglutinins were detectable. Thus the only result of the test might be the eliciting of low titre agglutinins to *B. typhosus* (1 in 100 or 1 in 200). Such has been designated the "vaccine effect." Table IX shows a weak agglutination reaction to *B. paratyphosus* A, and Table X the "vaccine effect," absence of *B. paratyphosus* A agglutination in a case in which *B. paratyphosus* A was isolated.

TABLE IX.

	Dilution of serum 1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000
B. typhosus ..	++	–	–	–	–
B. para A	+++	++	+	–	–
B. para B	–	–	–	–	–

Fourteenth day of illness. *B. paratyphosus* A isolated.

TABLE X.

	Dilution of serum 1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000
B. typhosus ..	+++	+++	++	–	–
B. para A ..	–	–	–	–	–
B. para B ..	–	–	–	–	–

B. para A isolated. Inoculations $\frac{T}{2}$ nine months previously. One month from onset of illness.

In a large number of cases clinically of the enterica group where no typhoidal organism was isolated, the only agglutination reaction obtained, even at the end of the illness, was such as that noted in Table X, viz., a reaction to *B. typhosus* only, not exceeding a titre of 1 in 200. The affirmation of a diagnosis in these cases is a matter of considerable difficulty; many of them, doubtless, have been reported by bacteriologists and accepted by clinicians as cases of true enteric due to infection with *B. typhosus*. It is, of course, impossible to state definitely in what manner such a result is to be interpreted. Our experience, however, of certain paratyphoid infections, as recorded in Table X, leads us to the view that a considerable proportion of these results are to be regarded as due to infection with *B. paratyphosus* A, in which no agglutinins were formed. The occasional non-development of agglutinins

during the course of an infection is a factor which limits the practical utility of the agglutination test, but it cannot be regarded as constituting a peculiar feature of paratyphoid infections in vaccinated persons. The occurrence of a "vaccine effect" without any agglutination of the paratyphoid bacilli is certainly a phenomenon which, for the present, is open to misinterpretation. With fuller knowledge of the whole subject, this difficulty may disappear.

It is probable also that in these particular cases of paratyphoid A infection, in which no specific agglutinins are demonstrable, some exaltation of *B. typhosus* post-vaccinal agglutinins may have been induced.

On the other hand, in *B. para* A infections there may be no reaction to either *B. typhosus* or the infecting organism. Table XI shows the negative result in a case of *B. para* A infection where this organism was isolated during a relapse sixty-four days from onset of disease.

TABLE XI.

	Dilution of serum 1 : 50
B. typhosus	—
B. para A	—
B. para B	—

Inoculated $\frac{T}{2}$ seven months previously. Test sixty-four days from onset of illness. *B. para* A isolated during relapse.

TABLE XII.

		Dilution of serum 1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000
2 hrs.	*B. typhosus* ..	++	—	—	..	..
	B. para A ..	—	—	—	..	..
	B. para B ..	++	—	—	..	..
24 hrs.	*B. typhosus* ..	++++	++	—	—	..
	B. para A ..	—	—	—	—	..
	B. para B ..	++++	+++	++	—	..

Inoculated $\frac{T}{2}$ five months previously. Test on sixteenth day of illness.

TABLE XIII.

		Dilution of serum 1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000
2 hrs.	*B. typhosus* ..	+	—	—	..	..
	B. para A ..	+++	+	—	..	..
	B. para B ..	—	—	—	..	..
24 hrs.	*B. typhosus* ..	+++	++	—	—	—
	B. para A ..	+++	+++	+++	++	—
	B. para B ..	++	—	—	—	—

Inoculated $\frac{T}{2}$ eleven months previously. Test on seventh day of illness.

B. paratyphosus A isolated.

No advantage is apparently obtained by testing the dilutions of the serum lower than 1 in 50 for *B. para* A agglutinins. Of course any standard is applicable only to the particular method employed, and the effect of a certain serum dilution tested by one method may differ quantitatively from that elicited by another. In those cases from which *B. para* A was isolated and in which the serum showed no evidence of agglutination to this organism in a 1 in 50 dilution of the serum, 1 in 20 dilutions were also tested with a similar negative result. What is probably of more importance is to make readings at periods later than two hours: for this reason the tubes were allowed to stand over night and readings were made on the following day. In this way we were able to elicit more striking results, which placed the diagnostic inference beyond doubt (as Tables XII and XIII show).

In general the twenty-four hours' readings were higher than those taken after two hours; certain weak co-agglutination effects were often noted after twenty-four hours, but these were rarely of higher titre than 1 in 50 or 1 in 100, even where the specific agglutinins were well marked (*vide* Table XIV).

TABLE XIV.

		Dilution of serum					
		1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000	1 : 2,000
2 hrs.	*B. typhosus*	++++	+++	+	–	–	–
	B. para A ..	++++	++++	++++	+++	++	–
	B. para B ..	–	–	–	–	–	–
24 hrs.	*B. typhosus*	++++	++++	+++	+	–	–
	B. para A ..	++++	++++	++++	++++	+++	+
	B. para B ..	+++	+	–	–	–	–

Inoculated $\frac{T}{2}$ seven weeks previously. Twelfth day of illness.
B. paratyphosus A isolated.

Table XV shows the progressive effect over a period of from two hours to nine hours, when the effect had apparently reached its maximum. This was found to be the general rule, but it was usually most convenient to make two readings, one after two hours at 37° C. and again on the following day after twenty-four hours had elapsed.

In all cases of course where no determining agglutination effect is obtained at an early stage of the disease, the examination may be repeated later with decisive result. Such repetition of the test in cases of *B. paratyphosus* A infection with weakly developed reactions has conclusively proved the diagnosis (*vide* Table XVI).

TABLE XV.

		Dilution of serum				
		1 : 1,000	1 : 2,000	1 : 4,000	1 : 8,000	1 : 16,000
2 hrs.	*B. typhosus* ..	++++	++	+	—	—
	B. para A ..	—	—	—	—	—
	B. para B ..	++++	++	+	—	—
6 hrs.	*B. typhosus* ..	++++	+++	+	—	—
	B. para A ..	—	—	—	—	—
	B. para B ..	++++	++++	++	..	..
9 hrs.	*B. typhosus* ..	++++	+++	+++	+	—
	B. para A ..	—	—	—	—	—
	B. para B ..	++++	++++	+++	++	—
24 hrs.	*B. typhosus* ..	++++	+++	+++	+	—
	B. para A ..	—	—	—	—	—
	B. para B ..	++++	++++	++++	++	—

Third week of illness. Inoculated twelve months previously.

TABLE XVI.

	Serum dilutions					
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000	1 : 2,000
B. typhosus ..	+	—	—	..	..	..
B. para A ..	+++	+	—	..	..	..
B. para B ..	—	—	—	..	..	..

Fourth or fifth day of illness. Inoculated eleven months previously.

	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000	1 : 2,000
B. typhosus ..	+++	++	+	—	—	—
B. para A ..	++++	++++	++++	++++	+++	++
B. para B ..	++	—	—	—	—	—

Thirteenth day of illness.

ANOMALOUS REACTIONS.

Much attention has been drawn to certain anomalies occasionally noted, e.g., the eliciting of powerful *B. paratyphosus* B agglutinins in a case where *B. paratyphosus* A has been isolated. Table XVII shows this somewhat rare effect.

TABLE XVII.

	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000	1 : 2,000	1 : 4,000
B. typhosus ..	++++	++++	++++	+++	+++	+	—
B. para A ..	—	—	—	—	—	—	—
B. para B ..	++++	++++	++++	+++	+++	+++	++

Inoculated $\frac{\text{T.}}{2}$ five months previously. Eighteenth day of illness. *B. para* A isolated from urine.

High titre agglutinins to *B. paratyphosus* B as shown can only be the result of infection or inoculation with the homologous organism: in this case *B. paratyphosus* A was isolated and there was apparently no agglutination response detectable on the

eighteenth day (and also after the third week). As already noted, this is not uncommon in *B. paratyphosus* A infections. The only conclusion to be drawn was that the case represented a double infection of *B. paratyphosus* A and B, from which only one of the infecting organisms could be isolated.

Co-relation of Isolation Results with the Agglutination Reaction.

While of course it has not been possible to prove the actual specificity of these paratyphoid agglutinins in all cases by isolation of the infecting organism, the co-relation of the isolation results when available with those of the agglutination test has proved of considerable interest.

Of thirty-two cases from which *B. paratyphosus* A was isolated twenty-three showed a specific agglutinin effect, eight showed only the vaccine effect or a negative result, such as that shown in Tables X and XI, and one the anomalous result recorded in Table XVII. Of eight cases where *B. paratyyphosus* B was isolated, all yielded evidence of a specific reaction. Thus with the exception of the single instance of apparent "cross agglutination," there was no discrepancy between the different results, and we have already offered a rational explanation of this anomaly.

The period intervening between the anti-typhoid inoculation and the date of the illness did not appear to influence markedly the type of reaction obtained in the paratyphoid infections; the longest interval among our cases was fourteen months, and in general the shortest three months; in one case the interval was seven weeks and in another eight weeks. The variations in the type of reaction did not apparently depend within these limits on this variable factor. Thus it could not be said that the concomitant *B. typhosus* reaction was higher in cases more recently inoculated, although in those cases in which no concomitant reaction occurred inoculation had been carried out more than one year previously. On the other hand, marked concomitant reaction to *B. typhosus* was recorded in cases inoculated even fifteen months previously.

In conclusion, it may be said that in the paratyphoid infections marked agglutination (+ + +) in 1 in 50 or 1 in 100 dilutions of the serum after two hours at 37° C. is of diagnostic significance; but that in the majority of cases striking evidence is obtainable by titration to the vanishing point of the reaction.

As regards the concomitant reaction to *B. typhosus*, this must be neglected altogether as being due to exaltation of the post-inoculation agglutinins.

B. TYPHOSUS INFECTIONS.

As might have been anticipated in an Army so efficiently protected against *B. typhosus* infection, the overwhelming majority of the total number of cases of enterica in the Mediterranean Expeditionary Force have been paratyphoid in nature; in consequence, the material available for the investigation test in true typhoid occurring in men inoculated with the *B. typhosus* vaccine has been so limited that it is only possible to make guarded statements regarding the standards by which a diagnostic determination can be made.

In a considerable number of cases presenting all the clinical manifestations of an enteric illness, the only result obtained was a weak reaction to *B. typhosus* (*vide* Table X), i.e., agglutination by serum dilutions of 1 in 50, 1 in 100, or in some cases 1 in 200, after two hours at 37° C. This has already been alluded to. Such reactions have been obtained in healthy subjects as late as nine months after inoculation, and this possibility has to be borne in mind. Again, a febrile illness not of the enteric group may lead to some exaltation within certain limits, of the post-inoculation agglutinins, and a true paratyphoid infection in which no specific agglutinins are developed may give rise to a similar effect. It is sufficient to recall those cases in which a result of this kind was obtained in Paratyphoid A infections (established by actual isolation of this organism). These results may therefore represent :—

(1) Post-inoculation agglutinins, either normal or exalted in value, not necessarily associated with any typhoid infection.

(2) Normal or exalted post-inoculation agglutinins in a case of *B. paratyphoid* A or *B. paratyphoid* B infection.

(3) A specific reaction in a case of *B. typhosus* infection; thus in one case where *B. typhosus* was isolated from the urine, the highest titre reached at the end of the illness was 1 in 200.

It was therefore quite impossible to base any diagnostic inference on such effects, and for all practical purposes the result of the test had to be considered as "negative."

In several cases the reaction to *B. typhosus* was registered in titres of 1 in 500, 1 in 1,000, and even 1, in 2,000. In one of these cases where *B. typhosus* was isolated, the result was as shown in Table XVIII.

TABLE XVIII.

	Dilution of serum					
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1, 000	1 : 2,000
B. typhosus ..	++++	++++	++++	+++	++	+
B. para A ..	–	–	–	–	–	–
B. para B ..	–	–	–	–	–	–

Twenty-one days from onset of illness. Inoculated six months previously. *B. typhosus* isolated from urine.

It is to be noted that co-agglutinins to the paratyphoid bacilli were quite absent. In another case where *B. typhosus* was isolated the highest titre was 1 in 500. In a case examined on the tenth day of the disease, the highest titre was 1 in 500. A further test was made on the thirtieth day, and the end point of the reaction to *B. typhosus* was found to be 1 in 4,000 (*vide* Table XIX).

TABLE XIX.

	Dilution of serum						
	1 : 50	1 : 100	1 : 200	1 : 500	1 : 1,000	1 : 2,000	1 : 4,000
B. typhosus ..	++++	++++	+++	+	–	–	–
B. para A ..	+	–	–	–	–	–	–
B. para B ..	–	–	–	–	–	–	–
Tenth day of illness. Inoculated five months previously.							
B. typhosus ..	++++	++++	++++	+++	+++	++	+
B. para A ..	–	–	–	–	–	–	–
B. para B ..	–	–	–	–	–	–	–
Thirtieth day.							

Though the diagnosis was not confirmed by isolation of *B. typhosus,* the occurrence of such a rise in the agglutination titre is strongly suggestive of infection by this particular organism.

Our observations have been necessarily restricted, but in the basis of the facts noted we formulated the rule that no reactions to *B. typhosus* alone, lower in titre than 1 in 500, could be accepted as indicative of true typhoid infection. In all these cases the date of inoculation has to be considered; all the cases dealt with had been inoculated at least six months previously. In recently inoculated subjects with high titre post-inoculation agglutinins the test would have been invalidated altogether.

In typhoid infection among typhoid inoculated subjects the scope of the agglutination test has become more limited than in the case of paratyphoid disease, and if the fallacies noted are not carefully considered in the interpretation of results, discredit is likely to be cast on this method of diagnosis. On the other hand, apart from such limitations, it is still possible to elicit in a very

considerable proportion of enterica cases significant indications from the diagnostic point of view. Whether agglutination as an aid in differential enterica diagnosis is destined to survive the still more complex group of factors which will come into play in the interpretation of these results in persons who have, prior to infection, received the triple enteric vaccine, it is at present impossible to foretell. Well-founded data on which such a conclusion can alone be based are in their very nature slow of accumulation, and we must await the collective results of various workers in the near future to provide the array of facts on which a final verdict may with safety be pronounced.

It is obvious that inferences from agglutination reactions, to have any value, must be controlled by identification of an organism isolated from the case providing them. It has been our aim in this paper to present interpretations of the agglutination phenomena in the light of such facts, and it is not too much to say that if the new phases of the problem which have just been indicated be controlled by the same standard, the resulting information will be valuable, not merely from the practical point of view, but undoubtedly also as forming an important contribution to our scientific knowledge of the whole phenomena in question.

PROTOZOOLOGICAL EXPERIENCES DURING THE SUMMER AND AUTUMN OF 1916.

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I AM indebted to the courtesy of the D.M.S. for permission to publish the following note:—

(a) Dysentery and Diarrhœa.

The cases dealt with in this note occurred during the months of June to November, inclusive. The opportunity has been afforded of studying the types of dysentery and diarrhœa prevalent amongst both British and Indian troops, and a comparison between the two has proved most instructive. The total number of different cases examined was 659, of which 378 were British and 281 Indians. A general classification of the stools, according to the presence or absence of pathological elements, is given in Table I.

TABLE I.—General Characters of the Stools.

Nationality	Totals	A. Blood, mucus and pus	B. Mucus and pus, but no blood	Total "dysenterics"	C. Diarrhœa alone
British ..	378	174 = 46 per cent	116 = 30·7 per cent	290 = 76·7 per cent	88 = 23·3 per cent
Indians ..	281	49 = 17·4 ,,	56 = 20 ,,	105 = 37·4 ,,	176 = 62·6 ,,
Total ..	659				

Nearly all the stools under the heading C were loose or thin, but occasionally one would be pasty or semi-solid. The majority of the 176 Indian diarrhœal stools were of trichomoniasis cases, and of a characteristic creamy or lemon-yellow colour. Most of the British cases were examined only once, or at most twice, because they were at a Stationary Hospital, from which the patients were soon as a rule transferred to a General Hospital elsewhere; but most of the Indian cases have been examined at least six or eight times, frequently more, at approximately weekly intervals.

Apart from *Entamœba coli*, included for purposes of comparison with histolytica, account is taken in Table III only of those parasites known or considered to be of pathogenic importance.

TABLE II.—OCCURRENCE OF E. HISTOLYTICA.

Nationality	Total findings of *E. histolytica*	Percentage of total cases	Histolytica-form	Percentage of total "dysenterics"	Percentage of blood and mucus stools	Tetragena-form and (or) cysts	Percentage of diarrhœal stools
British..	7	1·9 per cent	7	2·4 per cent	4 per cent	—	—
Indian..	44	15·7 „	13	12·4 „	26·5 „	31	17·6 per cent

TABLE III.—OTHER PROTOZOAN INFECTIONS.

Nationality	Number of cases	*E. coli*	Trichomonas	Macrostoma	Lamblia	Balantidium
British	378	6 = 1·6 per cent	3 = 0·8 per cent	2 = 0·5 per cent	7 = 1·8 per cent	—
Indian	281	80 = 28·5 „	122 = 13·4 „	33 = 11·7 „	10 = 3·5 „	2 = 0·7 per cen

Notes on Results.

(1) *Dysentery.*—A marked disparity has been found between the British and Indian stools as regards the occurrence of protozoan infections. This difference stands in relation with the difference, as a whole, in the character of the stools with two sets of cases (cf. Table I).

Dysentery among the British cases examined was, with few exceptions, *not* amœbic, but due to some bacillary infection. This was true in regard to the stools coming under both the two headings A and B. For undoubtedly the great majority of the stools under B (with mucus and pus alone) were also of dysenteric character, chronic or approaching convalescence. Many of them consisted chiefly of thick, ropy mucopus, whitish or yellow, sometimes bile-stained and with little fæcal material. My work has not dealt with the bacteriological aspect of the question, so that I am unable to give details of the bacillary findings. But *Entamœba histolytica* occurred in only seven cases (all of them blood, mucus and pus stools); that is to say, only 2·4 per cent of the total "dysenterics" were amœbic. In no instance among the British cases were pre-encysting forms or cysts found.

Among the Indians, the proportion of dysenteric stools was, in the first place, much less (cf. Table I), and of these relatively fewer were bacillary. On the other hand, amœbic dysentery occurred far more frequently than among the British, twenty-six per cent

of the blood and mucus stools, or twelve per cent of the total dysenterics, yielding *E. histolytica.* In addition, of the remaining stools, mostly diarrhœal, thirty-one (or seventeen per cent) showed tetragena forms and (or) cysts. In one form or another, histolytica was found in nearly sixteen per cent of the total Indian cases during the period under review.

Only in three cases altogether was a mixed amœbic and a bacillary dysentery found; one of these was British, the other two being Indians. Active histolytica were found at the first examination, and dysenteric bacilli were also isolated.

In every case except one, where the histolytica form was found, the parasites were present in the first stool examined, the exception being a loose, diarrhœal one. The reason, probably, for the absence of the amœbæ at the first examination was that this case was also one of trichomoniasis (the amœbic dysentery not being acute). As is seen from Tables I and III, trichomonas diarrhœa was responsible for a large proportion of the Indian stools sent in, and owing to this factor pre-encysting tetragena forms or cysts (in convalescent or "carrier" cases) were sometimes not found at the first examination, but were observed on a subsequent occasion. (A few such "carrier" cases may have been missed at first, owing to some patients being invalided back to India before more than one or two examinations had been made.)

The presence or absence of amœbæ in a dysenteric stool is the only *safe guide* on which to base a diagnosis of the type of dysentery from the characters of the stool-sample alone. Many cases, to all appearance similar, both macroscopically and as regards the nature of the cell exudate, have been met with coming under the category either of amœbic or bacillary dysentery. In a stool of dysenteric character examined within three or four hours of its being passed, *there will be no difficulty in finding histolytica, if this parasite is the cause of the dysenteric attack.* If the amœbæ are not found after careful search, the attack is not one of amœbic dysentery. It may happen occasionally that in a case of dysentery no histolytica are found in the stools during the acute period, but later on tetragena-cysts are observed. This signifies a mixed infection, the dysenteric stools in such a case being mainly or entirely (if the patient is an amœbic carrier) due to a bacillary infection.

(2) *Normal Carriers of E. histolytica.*—Up to date, the stools of 134 normal Indians have been examined for amœbic cysts. This series has included healthy men in camp and also men in

hospital for surgical treatment, malaria, etc., but in all cases men with normal bowel conditions. No fewer than twenty-seven (or twenty per cent) contained tetragena-cysts. The men were drawn from different sources (regiments, stations, etc.); many of them had only recently come from India and none of them had been on Gallipoli. The average number of positives kept fairly uniform right through; there was no question of many coming from one batch or source and few from another. So far as it goes, this result points to about twenty per cent of this class of Indians being naturally (i.e., in ordinary circumstances) infected with histolytica. *It is probable that on this account Indian troops were largely responsible for the outbreak of amœbic dysentery among the troops in Egypt and on the Peninsula in* 1915. A corresponding series is being undertaken, as opportunity avails, upon men of the Egyptian Labour Corps in the same area, and so far as this has progressed the percentage of infections with tetragena cysts is very much less, barely four per cent. Moreover, a certain number of non-dysenteric British stools (more than fifty altogether) sent in for "enterica," and not included of course in the above tables, have been specially examined for amœbic cysts and in no single instance were any cysts found[1]; i.e., among the British, at any rate in this area, very few appear to be carriers, and this agrees with the scarcity of amœbic dysentery amongst them.

(3) *Emetine Treatment.*—Including twenty-three normal carriers, the definite results of emetine treatment in over sixty cases are now known, and have proved excellent. Generally, the routine course of twelve grains of emetine hydrochloride, was followed. The care and treatment of these cases was in the hands of Captain F. H. Salisbury, I.M.S., and I desire to thank him very much for the interest taken and especially for his valuable cooperation in regard to the trichomoniasis cases (see below). Out of all the cases, only in three were the parasites still present when the course was finished. One of these was originally a dysenteric case, in which pre-encysting forms and cysts were then found (after the treatment was finished); the other two were carriers, in which a few cysts were also still present. But all three cleared up completely after a further four or five grains of emetine followed by a week's course of ipecacuanha. With these exceptions the results were straightway favourable. Thirty-five cases, including twelve

[1] Many of these stools were pasty or semi-formed, and likely to show cysts if an infection had been present.

amœbic dysenteries, the remainder being diarrhœal with tetragena forms or cysts, were all examined at least four times, often five or six, at approximately weekly intervals after the course was finished; in none of these was histolytica in any form ever found again. The carriers were usually examined twice, but a few three times, similarly, also with negative results. From conversation with two or three workers (I.M.S. officers and others) who have had experience of amœbic dysentery in India or China, I gather that larger initial doses may be given with advantage, say 1½ grains the first four days, or two grains for the first three days, followed up with one grain daily, till the usual total is attained. One worker in China had had uniformly good results by this method. There can be no doubt that it is all-important to give as much emetine as possible quickly, so as to kill all the amœbæ before they acquire tolerance to the drug and resistant forms are developed.

(4) *Remarks on the Amœbæ.*—I think that even at the present day it may be useful to summarize certain conclusions at which I have arrived, particularly as I have now had ample opportunity of comparing the unencysted forms of both histolytica and coli.

(*a*) If a stool consists of blood, mucus and pus and amœbæ are found in it, they will always be histolytica. Coli never occurs in the mucus and pus of a purely dysenteric stool; though of course, if the stool consists partly of fæcal matter in addition to slime, coli may be present in the former.

(*b*) In a dysenteric stool, there is more likelihood of an inexperienced person mistaking large macrophages for resting histolytica; this has probably occurred by no means infrequently in the recent past and I think it is still advisable to lay stress upon this point. Otherwise there is a danger of the number of amœbic dysentery cases being erroneously inflated. A large macrophage may be as large as a histolytica individual, not infrequently contains red-blood cells, and may show a clearer portion simulating ectoplasm. But it *very rarely* changes in shape, and if so, only very slightly, never actually progressing. On the other hand, when a resting histolytica wakes up, which some can usually be found to do, if watched for a time, the rate of change of shape or movement is rapid. The cytoplasm of a macrophage is more coarsely granular than that of a histolytica, and usually contains bright refringent granules of varying size. The nucleus of a macrophage, or portions of it (for the nucleus may be broken up) can usually be seen, contrary to what is the case in histolytica.

(*c*) The distinction between histolytica and coli: In loose diar-

rhœal stools it is often considered difficult to distinguish between these two types in the unencysted condition. But there are certain points which are of very great assistance in making the distinction. *One is the pronounced inactivity of coli.* Coli has been found in eighty different cases and few days have passed when I have not seen it in one of my repeat examinations. A large number of these cases have been loose stools in which unencysted forms of the parasites were generally present, either with or without cysts. In fifteen of the cases *E. coli*, in the unencysted form alone, was diagnosed at the first examination: in all these cases, coli cysts were observed at later examinations, and in none of them was histolytica, either active or encysted, ever found. (In some other cases, of course, both histolytica and coli were present together.) Now, even in freshly passed loose stools, unencysted coli individuals *are nearly always rounded and inactive.* If any do move, the movement consists mainly of change in shape, taking place gradually. Coli never show the quick-flowing movements which histolytica, even in the tetragena stage (the one usually met with in such stools) does.

The other point is the large conspicuous nucleus, with a well-marked ring of prominent refringent granules, possessed by coli. In the tetragena stage of histolytica the nucleus is sometimes readily visible (not by any means always) in life; but it is relatively small and has no such conspicuous grains of chromatin on the membrane. Now and again, in diarrhœal stools which show no obvious blood cells, tetragena individuals may be found containing one or two red corpuscles; the finding of amœbæ containing red cells in such a stool is conclusive evidence of the presence of histolytica. I have never found coli containing red blood cells in spite of the hundreds of occasions on which this form has been seen. But it is quite possible that coli may in certain circumstances (e.g., when the stool is a mixed fæcal and blood and slime one) ingest red cells; for I have several times found trichomonas under these conditions containing red blood corpuscles.

To sum up the matter, coli ought never to be mistaken for histolytica; histolytica in the intermediate tetragena form, occurring together with coli in loose stools, may now and then be liable to be overlooked unless attention is given to the above points, *when a correct decision can in nearly all cases be reached.*

(*d*) The meaning of the terms *tetragena* and *minuta.* It is important to note that there is no hard-and-fast line of demarcation between histolytica forms and tetragena (sometimes called minuta)

forms. I have had stools of amœbic dysentery cases, temporarily diarrhœal, in which a regular gradation and transition could be observed—all intermediate stages from moderately large histolytica forms down to small pre-encysting forms being present, and even one or two early cysts were once found. The origin of the pre-encysting forms is not to be regarded as a kind of special budding-off. process of small daughter forms from a large histolytica individual; it is rather by the ordinary process of successive binary fission taking place rapidly in certain conditions, and leading to a diminution in size. The term histolytica is best applied to those forms in the submucosa living entirely on blood-cells and possessing the well-known characters: the term tetragena, on the other hand, may be conveniently retained for those forms living in the bowel which ultimately give rise to the pre-encysting individuals and the tetranucleate cysts in the above manner. These forms usually live, of course, in the same way as *E. coli*, feeding on bacteria, etc., though, as noted, they may ingest red cells, if there are any available. In many normal carriers pre-encysting forms and cysts are quite numerous, indicating a heavy infection with this intermediate tetragena stage of the amœba[1]; just in the same way as the presence of *E. coli* cysts, with or without pre-encysting forms, indicates the existence of the ordinary large coli individuals in the bowel which are giving rise to them (although in a semi-formed or stiff stool the latter may not be actually present).

The term minuta should not be used for the ordinary pre-encysting form. As a matter of fact, the latter is not "minute"; it is frequently scarcely any smaller than a pre-encysting coli may be, because it usually shows still some relatively well-marked ectoplasm, up to the time when it contracts, rounds itself off and encysts. The name "minuta" should be reserved for the distinctly small type or variety, the cysts of which are only about eight microns in diameter, which is occasionally met with, unaccompanied by the usual form (*vide* Woodcock and Penfold, *Brit. Med. Journ.*, 1916, vol. i, March 18). I have also found this variety here on two occasions.

(5) *Flagellate Infections.*—Flagellates, either in the active or the encysted form, were met with only on eleven occasions (i.e., in three per cent) among the British troops, whereas amongst the Indians they occurred in 142 different cases (i.e., fifty per cent).

[1] It is unlikely that these large numbers could originate from histolytica forms in the bowel-wall without the latter being first of all numerous enough to produce manifest dysenteric symptoms.

Lamblia was found very seldom, whether among Indian or British. In four instances the infection was intense, patches of the shed mucosa being present in the stool, with enormous numbers of parasites attached, giving the appearance of a regular mosaic. Two of these cases were also found to be bacillary dysentery, but from neither of the others were any pathogenic bacteria recovered. A point to note about the cysts is that they are not always ovoid, but may be at times practically spherical. In such a case, usually the majority of the cysts are of a relatively short and broad oval form, only a small number being spherical, and with transitions between the two. But on one or two occasions I have seen only rounded cysts present. In such a case a little care is required in order not to mistake them for the cysts of histolytica.

Trichomonas was by far the predominating flagellate. This form occurred in no fewer than 122 cases among the Indians; most frequently it was the only flagellate present, but in twenty-two stools macrostoma (syn., tetramitus) was found in addition. Most of the stools in which trichomonas occurred were loose, or thin, diarrhœal ones. Sometimes a little thin mucus and scattered pus cells were present, while in a few cases manifestly dysenteric stools also contained the parasites. But the great majority of the stools, it should be noted, never showed a "dysenteric" character on any examination, and from none of them were any pathogenic organisms ever isolated. It may be repeated that these cases were purely trichomonas diarrhœa, or trichomoniasis. They were often very troublesome and chronic, and in many cases resisted all attempts at treatment. I may be able, in collaboration with Captain F. H. Salisbury, I.M.S., to give fuller details about these cases later, and will only add here, that while nothing like a specific drug for these parasites has been obtained so far, oil of turpentine, given in ten-minim doses three times daily for a week or so, the course being occasionally repeated, proved the most efficacious. Several cases were quite cured thus, but not, unfortunately, the majority.

The parasites were usually numerous to abundant, at times swarming. Occasionally large clumps or masses of still actively motile trichomonas occurred, resembling an agglomeration of trypanosomes in a culture. Notwithstanding the hundreds of times this parasite has been observed, I have never been able to find any cysts. It is known that trichomonas can live in the unencysted condition for several days in the external environment (e.g., the moist fæces). Moreover, I have succeeded in cultivating

this form in "pure mixed" culture in dilute peptone solution, though only for a week so far unfortunately. Fresh sub-cultures were made every second day and the parasites throve and multiplied vigorously until the fourth or fifth day, but after then they began to degenerate and by the seventh day were nearly all dead. On every occasion the bacterial growth appeared to swamp them. If the bacteria could be held in check, I have no doubt trichomonas could be cultivated for any length of time. Owing to the great pressure of routine work through the summer and autumn I was not able to give as much time to these experiments as could have been desired.

In the case of macrostoma, on the other hand, although this parasite was found in far fewer cases (only in thirty-five altogether), the cysts were seen several times, occurring usually together with some active forms. Macrostoma degenerates and dies more quickly outside the body than does trichomonas (resembling lamblia in this respect), and although I tried to cultivate it, I failed to do so. On one occasion I used a mixed infection of trichomonas and macrostoma, but only the former succeeded.

On the above grounds, I consider that *trichomonas may have lost the power to produce cysts*. Although if this is the case, and cysts are lacking in trichomonas, it will be a very unusual feature amongst intestinal parasites, I do not think it is by any means an impossibility. Woodcock and Lapage (*Proc. Roy. Soc.*, B. 88, 1915, p. 353, and *Phil. Trans.*, B. 207, 1916, p. 375) have shown that under conditions of intensive culture certain fæces inhabiting flagellates entirely lose their (normal) capacity to form cysts; and a heavy infection of trichomonas may aptly be compared with an intensive culture. I have found also that trichomonas will live and remain active for five and a half hours, both in ·066 HCl solution (estimated absolutely) and also in pancreated solution in the same proportion which has been found (*Brit. Med. Journ.*, 1916, i, May 20) to produce the excystation of *E. histolytica*. Therefore, I consider it quite likely that *infection with trichomonas can take place by means of the active, unencysted forms*, the parasites being probably taken in with water and passing quickly through the stomach.

(6) *Some General Considerations on Infections with Intestinal Protozoa.*—There is a prevalent idea that if a protozoan is pathogenic, its presence must always be associated with symptoms; that if a particular parasite can be found in normal persons, that fact is sufficient to disprove its pathogenicity. This view is quite contrary

to the biological principles determining the relation between a parasite and its host. The series of Indian normals I have investigated (see above) is most instructive in this connexion. No less than twenty per cent are carrying normally the cysts of *E. histolytica*, the protozoan universally recognized as the cause of one severe type of dysentery. Now it is extremely improbable that anything like that proportion have suffered, or will suffer, from amœbic dysentery. And this result only bears out, on a larger scale, the observation already recorded by Woodcock and Penfold (*l. c.*) of the occurrence of carriers among the British invalided from Gallipoli, who had never suffered from dysentery or even diarrhœa. The conclusion may safely be drawn, therefore, that in a certain percentage of cases—no inconsiderable one, probably, in endemic areas, such as India—this pathogenic amœba lives normally in the gut, without necessarily ever giving rise to symptoms. As above explained, it lives in the tetragena-form, behaving exactly as *E. coli*. For the amœba to give rise to dysentery there must be some lesion or derangement of the bowel—at least, some non-normal condition—lowering its resistance and giving the amœba its opportunity.

Precisely the same reasoning applies to the intestinal flagellates (e.g., trichomónas, lamblia) and the ciliate, balantidium. Like histolytica, they may occur without causing any symptoms; but on the other hand they are *potentially* harmful. If there is any disturbance of the normal bowel condition, and its resistance is impaired, the balance is no longer maintained, as between host and parasite, the flagellates are able to thrive more vigorously, multiply more actively, and in their turn cause a more intense reaction on the part of the host, setting up, as it were, a vicious circle. It is not yet known if definite toxins, in the strict sense of the term, are produced by these intestinal protozoa, but it is certainly to be expected that the presence of a vast number of parasites in the intestine, with the concomitant production of waste metabolic substances, is sufficient to irritate the mucosa and give rise to deleterious and toxic effects. Fortunately the flagellates appear to be unable to penetrate the mucosa, in the way that *E. histolytica* and *Balantidium* can (given favourable conditions), and therefore, never (?) produce true dysenteric symptoms, the derangement being generally limited to severe or mild diarrhœa.

(*b*) Malaria.

A few words may be added in conclusion with regard to the malarial examinations for which I was responsible. During the

period from August 1 to November 30, 857 cases were examined for parasites, not counting more than 100 repeats. Until July there was scarcely any malaria, but during that month it began to increase. The worst months were September and October. Parasites were found in forty-three per cent of the cases, and especially among the Indians; quite five or six per cent in addition were obviously malarial bloods, although no parasites could be found. The findings are summarized in Table IV.

TABLE IV.—Cases of Malaria, August 1 to November 30 inclusive.

	Examinations made	Number positive	Malignant tertian	Benign tertian	Quartan
British	463	178	66 = 37 per cent	112 = 63 per cent	0
Indians and Egyptian Labour Corps	374	192	153 = 79·7 ,,	37 = 20·2 ,,	2 = 1 per cent
Totals ..	837	370	219 = 59·2 ,,	149 = 40 ,,	2 = 0·5 ,,

Among the British, benign tertian was twice as frequent as malignant tertian (pernicious), but among the Indians and Egyptian Labour Corps the malignant form was by far the most common. The rarity of quartan cases was noteworthy, only two being met with, both occurring in Indians. I was struck by the scantiness of the parasites in quite a number of the benign tertian cases among the British. Probably insufficient prophylactic dosage of quinine was responsible, checking but not completely inhibiting the development of the parasites.

In all the British malignant cases, the parasites (in the ring-form) were frequent or numerous, whereas the contrary was often the case among the Indians. On two or three occasions, malignant parasites very bacilliform in character were seen, but a few typical rings could always be found by searching. Crescents were never found in the British cases, as nearly all of these were new infections. Remarkably few mixed infections occurred, not more than three or four altogether. Only three fatal cases came under my notice, one of them being British and two Egyptians. These occurred at the onset of the season and were rapidly fatal cerebral cases. They were, in fact, only diagnosed post-mortem by finding abundant malignant parasites in the spleen.

SOME MUSINGS OF AN IDLE MAN.

By Colonel R. H. FIRTH.

I.

A short time ago, I was billeted in a house where, in a small paddock at the back, roamed a donkey. He was a confidential, friendly beast and my frequent companion as I leant over the fence enjoying a quiet smoke in idle hours. Rubbing that donkey's nose as he smelt my coat over for carrots or biscuits, one could not help wondering why his race had become synonymous with stubbornness and brainlessness, to say nothing of contumely and abuse. Certain pictures in books of childhood days came back to memory, wherein a similar beast was almost glorified in a childish mind because of its association with the Christ, and certainly regarded as an intimate friend. The animal before me had a well-marked cross on its back and shoulders, a mark supposed traditionally to have been bestowed upon its race as a memorial of the day when one of its kind bore a Man through the streets of Jerusalem. I may be wrong, but memory suggests the thought, that in some parts of Europe, the Christian Church at one time held a festival in honour of the donkey, in commemoration of the flight into Egypt. However much that festival may have been conceived originally in praise of a donkey's good deeds, it soon degenerated into a comic saturnalia and from that time the donkey meant insult or opprobrium, and not an object of veneration or respect. That the donkey was ever venerated, may be descended in some way from a pre-Christian cult or form of ass-worship. We know that the Egyptians worshipped their god Seth in the similitude of a donkey, and one of the charges against the Jews in early times was that they were donkey worshippers. Later, the accusation was transferred to the Christians, and Tertullian tells the story of how an apostate Jew carried an ass-headed figure through the streets of Carthage, with an inscription stating it to be the god of the Christians. As late as the third and fourth centuries, caricatures of the tragedy on Calvary were current, in which the figure on the cross was drawn with a donkey's head. Some scholars suspect a mockery of the Christian religion in that fantastic comedy of Apuleius, called "The Golden Ass." Even in our own country, old coats-of-arms are to be found in which an ass-headed figure

holds a prominent place and, if my memory serves me well, the figure associated with the motto of a well-known public school and to the effect that "Manneres makyth manne," is also donkey-headed or at least a pig with donkey ears.

It is quite evident that the donkey has had a chequered career in man's estimation. He has been a god and in "A Midsummer Night's Dream" has even supplied a head to Bottom the weaver. Our modern press has proclaimed the beast's presence in the second chamber of the Legislature, and even hinted that a problem of the times is how to drive the wild asses of the devil back into the nether regions. Allowing that this may be an exaggeration, still both in the past and the present there has been and is no greater danger than the ass. History is an epic of the destruction of donkeys or of the destruction which donkeys have brought upon people. It was the asininity of Charles I that lost him his throne and life. It was the obstinate asininity of George III that lost us our American colonies. It was the asininity of the French Queen and her court that put the spark to the bonfire known as the Revolution. Not only a giant, but many a big and good scheme has been knocked out by the jaw-bone of an ass. The donkey has cut this figure in history because its obstinacy is more lasting than character and more insistent than wisdom, which is the same thing as saying that the wise man will get tired of being wise sooner than the donkey gets tired of being an ass. Possibly, this is the clue to the real strength of the donkey and why his bray echoes down the centuries, like the voice of a conqueror. We find donkeys, in human form, in every walk of life and, overwhelmed with the presence of a multitude of them, we feel we have enough of our own and proceed to forget the donkeys of a generation before.

Whether he has four legs or two, the ass is said to have the least social sense of all animals, and generally is less responsive than a cat. The donkey is as unteachable as he is serious looking. He always looks serious, even at times at which one suspects him of something like devilry or frivolity. Unless we realize what the human donkey has accomplished in the past, there is danger that we underestimate the peril he is to our own time. Had it not been for the donkey, it is possible that we should have reached the end of this war long ago. But the ass has always insisted upon knowing better than anyone else and, on the plea that it objected to its present driver, has lain down in the road. The beast seems ever to suggest that, if it only had another driver, it would proceed

at a gallop. Yet, when you give it another driver or leader, it still protests. If our donkeys could unite together they would make the world an impossible place; fortunately for us they do not unite and so we carry on. There is an asinine seriousness about those who belittle vaccination or challenge the value of inoculation against the fevers of the enteric group. Similarly we cannot exonerate from asinine relationship the doctors with a field army who, because they are not called daily to tend wounded men, think there is nothing for them to do. More important cases come to mind than these. There are many politicians whose minds are busy continually with serious frivolities and obstinate inanities. This suggests the thought that the best materials for illustrating the natural history of the donkey exist in "Hansard" rather than in "Buffon." A great feature of all the donkey tribe is that they are either inordinately shy or inordinately inquisitive. Our daily Parliamentary reports afford ample evidence of the presence in our midst of the inquisitive variety of ass. As one thinks and reads of all these people, we realize how they contribute nothing but noise and obstinacy to a situation which demands brains above all things. These are no frivolous thoughts jotted down in mere wantonness: one sees too much around one now to doubt the danger from the presence of the donkey among us. Still, we have the consolation of knowing that on the side of asininity the gods fight in vain and, though geese did save the Roman Capitol, we may be quite sure that it is not donkeys that are going to save our imperilled empire. Our only fear is lest ass-worship should revive to any degree in our own or allied countries; if it do, then victory and progress may be deferred to the Greek Kalends. At this I would leave it, as my confidential musings over the fence with a friendly "Neddy" have carried my thoughts further than I meant them to go.

II.

A few days ago, I caught myself gazing at a representation of our Royal Arms, with the legend beneath of *Dieu et Mon Droit*. The question flashed up, what does "God and My Right" mean and what had Richard I in his mind when he made these words his battle-cry at Gisors? In feeling for the answer, other thoughts came crowding along. Not the least was the realization that these words are on our lips to-day, and also on those of our enemies. Both we and they claim God to be an ally, and unless one or other of us be hopelessly wrong, then God is on both sides. Had we

been living two thousand years ago, this would not have been surprising, because the gods of old varied from tribe to tribe and nation to nation, so that when groups of people arranged themselves in battle against their enemies, they fought on the assumption that their own gods welcomed the opportunity of supporting a movement for the overthrowing of the unbeliever. But this ancient simplicity is gone, and Christianity has internationalized the idea of God. We moderns have replaced the tribal gods by a Universal Spirit susceptible to infinite interpretation, yet remaining one and the same Deity. Therefore, we must obtain the solution to the asserted problem that God is on both sides by some process of thought.

Careful reflection suggests that we should leave God out of it, as it is unthinkable that He should be on both sides, or take sides at all when either combatant depends only upon the power of material advantage. The clue to the difficulty appears to lie in a remark made to me some time back by a man, that the only way to forget the War was to be in the trenches, where newspapers were not easy to get or read. He did not realize the full meaning of his words, nor did I at the time, but fuller consideration suggests that they were pregnant with meaning. Those who know of the War only through their newspapers lose perspective, having only one view, namely, that of a vast war gripping Europe, and causing sympathetic convulsions in other continents. From the human standpoint, that constitutes an illusion. The fact which we have to grasp is, that there is not one war, but many millions of wars; for there is a war in the minds or souls of all individual fighting men. In so far as these soldiers, irrespective of nationality, fight freely and independently for a cause which they as free and independent beings believe to be just, God is on their side in the only way in which He can be on their side. It is not a question of winning or losing, or of living or dying. These are mere side issues, and we draw the inference or belief that God is on the side of those who fight for what they believe to be right, and the joy these men feel in being able to satisfy conscience in that way is the great victory. My musing, therefore, brings us to this: that God is not on the side of one nation any more than another. He is on the side of those who have given themselves freely and fearlessly to a cause they believe to be good. In this sense we can interpret the true significance and meaning of Cœur de Lion's battle-cry of "Dieu et Mon Droit."

III.

Among interesting studies of the present time is the observation of the psychology of those about one, be they men with whom one lives in mess or be they casual acquaintances. One refers now to the curious ebb and flow of confidence as to passing events and the progress of the War. One day there is an atmosphere of depression, and on another the air is full of optimism. In spite of the frequency of these variations in the psychic barometer, one finds it difficult to advance a positive reason for the changes, unless it be the unaccountable restlessness of the human mind. Reflection suggests that the prime factor is rumour, because the people who display these fluctuations of confidence and misgiving have no standard steadily before them by which to judge the significance of daily events. In the absence of authoritative information they feed on the latest rumour and, not having things in proper perspective, that rumour fills the skies of their vision, so that they are unable to judge the true value of either sunshine or cloud. To the better balanced a local success is no more an index to the greater issue and result than a temporary reverse. History is our best food under these circumstances, and nothing better than the history of the Peninsular War. In that campaign Wellington was as often retiring as advancing, but he never let retreat spell defeat; he was content so long as a retreat served its purpose in the main scheme of lasting longer than the enemy.

There is an old adage to the effect that a little knowledge is dangerous, and this may be enlarged to mean that there is nothing makes a man suspect more than to know little. In these times, when the abeyance of full publicity is often required for military reasons, lies a true tragedy. The consolation to that tragedy is the circumstance that it is the part of the patient to hold up against rumour, so that the State may come to no injury; in other words, we need ever to think largely, and see things in proper perspective. The person who allows his nerves to harden or weaken because he judges by the immediate event, and not by the general tendency, is bound to be a prey to, even awed and appalled by, rumour. There is no alternative, since he has no hold on essentials. To such a man every straw seems as large as a tree in the flood, and he clutches it and holds it tight till he sees an even bigger straw. He communicates his joy and his gloom to all about him, and the temperature of a whole community may rise or fall accordingly. If he is up one day and down the next, it is for some reason which those

not in possession of his particular set of secrets cannot understand; he changes for no overt reason. The situation reminds one of a wayward woman whose tempers were such:—

> "That the knights eyed her in suspicion,
> And the dames whispered scoffingly—
> 'Her moods, good lack! they pass like showers!
> But yesternight, and she would be
> As pale and still as withered flowers,
> And now to-night she laughs and speaks,
> And has a colour in her cheeks.
> Heaven keep us from such fantasy.'"

IV.

My daily ride takes me frequently past a certain casualty clearing station, housed in a building which bears the legend, "Institution N.D. d'Esperance." I rarely pass the place without thinking how appropriate is the name, and also how much must hope and faith fortify those who have to enter its mud-splashed gates. Obviously the word "hope" implies doubt, and doubt is a huge factor in the modern world. In our youth we were taught that the three cardinal virtues were faith, hope and charity; it is curious to note how these are constantly changing their values. Few of us will be inclined to affirm that faith is just now the greatest of these virtues, while charity, which for many years held first place, seems to be losing its hold on the human mind. Its place seems to be taken by hope, which makes terms with doubt; while faith simply deprecates it and charity ignores it. One does not think here of that hope which is the result of the judicial weighing of facts; such hope is mere opinion. The hope which stands with faith and charity is the antithesis of spiritual despair; it neither calculates nor dreads. It goes without saying that faith is the goal of every man's search, but many of us desire it in vain because certain natures are not capable of faith, or rather that certain mental atmospheres prevent its action on certain minds. Such atmospheric conditions are widespread in the present day.

Every age has its own form of esoteric experience, and hope seems to typify the spiritual and esoteric experiences of the present age, very much as faith expressed that of the recent past. The chief charm of faith seems to be that, like the manna of old, it can be had for the asking. It is not the exclusive privilege of the few, for dolts and worldlings share it with men of high moral standing. Whether they deserved it or not, our grandparents had

faith, and by it they were consoled in life and upheld in death. In their day, to give any thought to spiritual matters involved the doing so in unquestioning faith; this they did unconsciously, and managed to find most of the problems of life solved before their eyes. They did not believe many things which most men now know, while we believe not what we will, but what we can. Then came a day when science threw bombs suddenly among the faithful, and men turned to charity, and declared philanthropy to be the only refuge. In altruism they found an inspired consolation, but it is a religion without hope, and does not satisfy the hungry heart. The secret of all this lies probably in the fact that the whence and the whither press more heavily on man's imagination than the now, with the result that the present day cataclysm is marked by a revival of hope. This hope, which is the characteristic of our time, differs from faith because it cannot assert or testify, and is more likely to silence a man than make him speak. But, if it is not expressed, yet how many of those who see sorrow can testify to its strange influence. Men and women who never belonged to the household of faith are serene and brave in the face of bereavement, and, to their own amazement, are upheld by hope. We can trace the same influence in the marvellous cheerfulness of men in the hard and depressing circumstances of the trenches. That at this time there should have been such a revival of hope is a puzzle, but just as the origin of life remains a secret, so, in the spiritual world, the secret of revival is an analogous mystery.

V.

A recent visit home enabled me to enjoy an unusually fine day of late January in the Hampshire country. Strolling through woods and across meadows, all around was evidence from the songs of birds that, in the lengthening days, the birds had chosen their nesting places for the year. As a student of Nature, I knew that birds seldom sing unless they are attached to a definite piece of ground. The impulse was irrepressible to sit down on a bank and, with comforting pipe, watch the life around and think. A little paler than the leafless boughs beneath it, and browner than the grey sky above, I saw and heard a missel-thrush throwing its sweet music into the teeth of a north-west wind. In its confident defiance of the wind's bluster, the song of that missel-thrush seemed to bring spring a good six weeks nearer. I glanced about, and saw the golden drops of the aconites and the white-tipped spears of the

budding snowdrops all telling the same story of Nature bursting into new life; while, but a few yards away a great tit, with his deep crimson breast, hopped about and with his sharp see-saw cry supported the rhythmical spring chant of an adjacent wood-pigeon, who seemed ever to say "Take two cows, Taffy."

In such surroundings, the War with all its sordid yet pathetic incidents was forgotten. One had come back to Nature and felt oneself akin with her who, in spite of all her bareness, signalled right and left the beauties and the joys to come. The birds fascinated me, they were so confidential that one regarded them all as friends. Then I began to think and try to recall all that I knew of birds, little scraps of knowledge picked up in boyhood days when I roamed the fields, copses and hedgerows of Hertfordshire, all free from worries or regrets as to the disappointments of life. One remembered the incident of a cock song-thrush who piped day by day from the same tree over the same shrubbery in a garden of my youth, tolerating wrens, hedge-sparrows or robins in the claim which he thus announced he had staked out. Woe betide any other thrush that came near him. All this meant then and means now that most birds at nesting time, and for some time before, are more the enemies of their own kind than of other species. The territories of birds of different species overlap freely, but birds of the same kind infringe each other's area very little, and only at risk of a battle. Every territory marked out in late January or early February by a thrush or robin or blackbird means a nest in that territory later on, unless some accident upset the plan. The acquisition of a territory seems almost more important to a cock bird than the choice of a mate; for it is not unusual to find a robin or a thrush singing vigorously about his territorial claim long before there is any sign of his companion. The explanation is probably economic for, necessary as it may be for the singer to get a mate, it is equally indispensable that the foraging area be ample. Nestlings will not eat the scraps from bird-tables, they need the natural food of their kind; this is why their unconsciously provident father stakes out and will defend an ample hunting-ground weeks before the nest is made or begun.

Another fact came to mind, and it is, that birds which wander least begin to sing soonest, and that is why our garden birds which stay with us all the winter are found singing and building long before the same kinds in the open fields or woods. Resident birds, such as blackbirds, defend their territories through the winter by constant chattering vigilance, though they seldom

sing before the end of February. Others, like partridges, have no real song, but even they guard their frontiers with characteristic spring cries. There is no more certain index of the lengthening day than the cock partridge's sharp call in the furrows, which means that these birds have begun to leave their coveys and form pairs. Then again, what more suggestive than the actions of a small blue tit just above me? High in a tree, he hops about, tugging at desirable morsels which seek to evade him, and all the time emitting those elfin calls which, though hardly a song, are a veritable music of the spring. As one watches, one figuratively figures each tug the bird makes as the pulling at a bell which breaks into a silvery jingle as a signal that every closed bud should hear the summons of Spring and prepare for the new life. And so one might ponder on indefinitely, but time flies, and the failing light gives warning for a return to human realities and shams. I wander home, consoled by the thought that Spring will keep her tryst as usual, but tempered by another thought, for how many will it not be the last?

VI

One of my messmates returned a few days ago from leave, and on being asked how he had enjoyed himself, remarked "Ripping, had a splendid time." Knowing the man well, I easily pictured to myself what he considered a good or splendid time, as summing up so much of personal enjoyment. How far it differed from my own conception of having a good or splendid time is immaterial, but one could not help analysing the whole question of thoroughly enjoying oneself. If life becomes sufficiently dull, one may be driven to all sorts of devilries in sheer desperation and in order to amuse oneself. I am conscious of many hours in my own life that have been ordered by the desire to have a good time. It amounts to this, that life may be so dull and monotonous that the feeling comes that one must be interested or die. If a man cannot interest himself in what are regarded as virtuous things, he will try and secure diversion in some other way. Obviously, the recognition of the fact that man must busy about something, and that very few people can loll into virtue, suggested the line "Satan finds some mischief still for idle hands to do." It was said of Molière that he desired to be thought a reformer as well as an entertainer, and there are many others who do not care to admit either to themselves or to others that they are chiefly bent upon self-amusement

rather than upon amusing other people. I am not so sure but that I do not fall into this category myself, and that the value I get in filling up idle hours in scribbling so-called "musings" may not play with me a greater part than the possible amusement they may afford to others.

The philosophy of intense individual enjoyment or, in the language of the day, having a splendid time of it, is rejected instinctively by everyone who has the slightest social sense. The most audacious apostles of ultra-individual enjoyment are children, for every child takes its right to happiness for granted and regards the day as something designed specially for its enjoyment of games and things to eat. Most unwillingly it sees its right to a good time limited by the insistence of others upon similar rights. As the result of disciplinary correction and experience, children usually discover the necessity of confining their claim to what they call a good time within decent limits. Possibly, it is simply that they learn that the social way of having good times is preferable to the individualistic; but that just makes all the difference. It is not merely a change from a lower to a higher kind of epicureanism, it is the recognition of the claims of other people. Herein lies a fundamental truth for the whole body politic, and which has sooner or later to be grasped by every man who is not to grow up a criminal or a lunatic. It was the negation of this truth that justified Nero, in his own mind, in setting fire to Rome in order to enjoy the blaze. This reminds me of another story from the classics, of another Roman who, when a friend remarked casually that he had never seen a man killed, at once ordered that a slave be slain in his presence that so natural a curiosity should be gratified. If the right to individualistic enjoyment is unlimited, then the logic of it cannot be better expressed than in the words of Keats, "Oh for a life of sensations rather than of thoughts." Modern hooliganism may be explained as a symptom of this thirst for change, excitement and sensation.

So far, one has thought rather of the baser than the higher ways of extreme enjoyment; but, obviously, if we admit the general principle for the one we must do so for the other. I think it was Epicurus who defined pleasure in terms of virtue; but the thief and the criminal have the right to complain that such a definition is arbitrary, and suggest a re-definition in terms of their pet predilection. As a matter of fact, experience teaches us that the man who deliberately seeks only his own happiness and pleasure, as the sum of all good, seldom turns to philosophy or goes and

contemplates Nature. That man will not write a rhymed verse, or gain a V.C., or even become a useful town councillor. As one thinks over the situation, the clearer it becomes that modern civilization is dominated by a gospel of power and pleasure for oneself or family, and duty for other people; there is little heard of a gospel of universal pleasure. The present war has accentuated this and broken in upon our pleasures and good time, so much so, that the right to have a splendid time is no longer a right; it is a mere concession on the part of society and destiny. Society grants its privileges unevenly and probably will continue to do so, until we learn to think in a clear way as to rights and duties. It is very easy to propound a theory of duties applicable only to certain classes, or frame a theory of rights which refer only to oneself or class. It is the business of all good citizens to think out a philosophy of duties and rights which will apply to all. The gaining of pleasure, happiness and opportunities of having a splendid time will follow as the natural result of our being wise enough to think about something else. The conclusion, therefore, follows that there seems no surer way of missing pleasure than by aiming at it, and that there is no surer way of getting it than by not worrying about it.

VII.

Not long ago, I found myself in the *Gazette* as superannuated, on attaining a certain age, but retained on the active list in consequence of the War. To every Service man, the day when he is jettisoned as old and unwanted must be a sad milestone among the years. I own that to myself it was a sad day, for it meant the breaking of old ties, routine, habits and associations. One recalled all one's career, the ardent and ambitious hopes of early years, the stern jars and shocks of later times which made one see oneself as others saw one; then the slow but steady realization of the fact that the highest point was passed, and that henceforth the path was but a slope leading ever down to the day when the word would go forth for one to step off the official stage. Involuntarily, one cast up the balance-sheet and, with humiliation, saw that the balance was indicative of but one more recruit to the great army of failures and derelicts. Such were one's thoughts; but one is not now going to dwell on them. The situation engendered other thoughts, and they may be expressed thus: In the holocaust of conventions, which will be the monument of this

war, the revision of conventional views of age and time have long ago found a place. The present struggle, with its demands upon the military manhood of the country, tends to retard the age-limit, to classify middle-age as youth, to demand of old-age the efforts of middle-age, and to deny the rights of rest and retirement even to senility. This means that we have changed our former fixed convention of Time and that, if the War needs us all to adapt our ages for military use, we must induce Time to make us a loan on terms as favourable as we can expect from a hard lender.

Most are familiar with the epigram about those rivals and companions, the body and the soul; how the body is born young and grows old, while the soul is born old and grows young. Who can deny that the average adventurous soul grows younger and younger, interested more and more in things, and more and more deeply rooted in life? Therefore, in critical times, it is natural and not surprising that the elderly people should be as ready as the youths, since they have the younger souls. From the military point of view, however, the body unfortunately matters more than the animating essence within it. However, the recruiting and drill serjeants are no psychologists. They make no rally of souls, but judge men by their muscles. Hence our abolished convention and our master Time come in for their own again, and the serjeant's estimate of the period of youth holds good for the period of the War. But when precisely does the body age according to military experiences? It has been answered in many ways: That one is as young as one feels, or as young as one looks; that some are old at 40 and others young at 50. The truth is, it depends on the man and only he can decide, since only he knows how old he feels, and therefore is. I am here reminded that Bacon said: "A man that is young in years may be old in hours, if he have lost no time." Further, in more frivolous vein, one can describe the seven ages of man in seven words, each of seven letters; they are toddler, learner, flirter, fighter, humbler, trifler, mumbler. Doubtless other variations may occur to the reader.

This war has emphasized the old conflict between body and soul by insisting upon a more or less rigid demarcation that conflicts with ambition in those past military age, while at the same time softening such demarcation so that as many as possible of those whose souls have been growing younger can ignore the steady ageing of their physical frames. In these matters war means a contradiction with a bias towards crude physical facts. The recruiter aims at the inclusion not of the youthfully middle-aged, but of the

middle-aged youth; he prefers a dull or bored young man with a broad chest to an ardent volunteer with greying hair. By this he implies that the weight of the knapsack matters more than the weight of shame consequent on inability to serve, and that, as war sifts it out, youth is more a matter of body than soul. Just as enthusiasm is useless without muscle, so good intentions will not move heavy guns, though good brains may be needed to both conceal and use them. Hence in this war there is disappointment for most of the middle-aged; they felt themselves younger when the War began, but feel themselves old as the State rejects them. This mortal paradox suggests a plea for a state of existence wherein power shall correspond with desire, and intention compel achievement. In that Utopia men shall die when they deserve to die—that is, when they feel old—and men shall continue to serve on so long as they feel young. It is immaterial whether this Utopia ever was or ever will be, for clearly I myself served either too soon or too late to enjoy such a regime. I leave the subject with the old French refrain on my lips:—

"La vie est brève,
Un peu d'espoir
Un peu de réve
Et puis: bon soir."

VIII.

In the preceding note one has put down certain musings arising from the return of one's birthday as marking the official limit of military service. Further thought suggests that it and all anniversaries are but a way by which we try to lay hold of flying Time and induce him to yield some of his hoarded treasures. If this be so, then it is not an illusion that days may be re-summoned from the past and lived again. The interpretation we place on those days would appear to vary with our years, for each one of us experiences as he grows older a change of mind towards that which an anniversary celebrates. In his brief and limited experience of life, a child can imagine nothing of importance comparable to the importance of his birthday for, to him, it is the unconscious expression of delight in life itself. But as we grow older our birthdays assume a different aspect, partly from a doubt as to the degree of benefit we ourselves derived from being born, and partly from a natural reluctance to be reminded of the number of them, or of the increased rapidity with which they seem to fly past.

Honest reflection suggests further that anniversaries are successful in inverse proportion to their number, simply because they should give occasion both for anticipation and retrospect. In this lies the clue to why the child has the best of it: to him, anticipation holds the field, whereas to the man it is retrospect which plays the bigger part. Although retrospect is by no means so undilute a pleasure as anticipation, still it is one of the main ways in which human intelligence can lengthen and multiply its experiences. A well-balanced or properly celebrated anniversary should spread its influence both before and after itself. This even may be said of what are truly sad anniversaries, or those by which almost every day of this year will be especially solemnized by a great number of people in the countries now at war. Many of us have lost dear and valued friends and, as the anniversary of their death comes round, the refreshful thought obtrudes itself that it is surely better and more comforting on such a date to meditate not so much upon what we have lost, as on the many delightful hours which the companionship of our departed friend brought us. The people we like or love are but fellow-travellers who walk in our company a part of the way through life, and at some point or other drop off, or turn aside into another road.

Another way of looking at this question is to keep no anniversaries at all. Some people regard every annual recurrence of some marked day as a sort of writ served upon them by fate with notice to quit at the end of some unspecified time. This attitude suggests a panic-stricken way of looking upon life. After all, the passage of years need not be regarded as an unmigitated misfortune. Few will be prepared to say that the brevity of life is an ill, for life is but a cycle. If it be lived properly, its end is just as natural and just as welcome as any other change. Every age has peculiar advantages and peculiar disabilities; and those who refuse to grow old naturally and make the best of every age are like dissipated people who refuse to go to bed, but sit up all night. Therefore, there seems little cause for not keeping our anniversaries and certainly no need to be upset by the thoughts which they arouse. The present times suggest that too much anticipation is disturbing, and that a little retrospect can do no harm. There may be a long road to look back upon, but there is the satisfaction of knowing that no dangers can threaten us from there, for they are all past.

IX.

News was brought in a few days ago that So-and-so had been killed. He was a man whom I knew well, and the thought came at once, "*What a pity! he was such a gentleman.*" As I sat thinking of my dead friend, I could not help wondering what it was that made him such a gentleman, for he had not been born with a silver spoon in his mouth. Involuntarily, I asked myself, now what is a gentleman? The answer seems to be that the test of a gentleman is the degree of pleasure others take in his society, and not in his wit, or virtue, or learning. Unlike the poet, the gentleman is not born, though some people do talk of a born gentleman. Of course, there are men who think they know how to be a gentleman by nature, just as if they had inherited good manners like a property or title. That type is more disliked, but perhaps less laughed at, than the man who tries to be a gentleman in the reverse way, and the generalization is permissible that the man who is disliked may be sure that he has not succeeded in being a gentleman. For the peculiar virtues of a gentleman are the qualities that give pleasure to others, and, if he has vices, they are not the vices that we hate instinctively.

Thinking it over, one realizes that the gentleman is essentially the man who is at ease everywhere, or with every one, and they are at ease with him. The secret of this is, he knows enough about life to test his success not by his own ease, but by that of others; or, to put it in another way, it is his advantage that he can only enjoy his own ease by making others easy with him. Many a gentlemen is selfish, but he is not an egotist, for egotism does not smooth life. To the gentleman, nothing may be very important, but among all the other unimportant things he includes himself and his own affairs. The true gentleman is never upon his dignity, for dignity is a something that we attain if we know how to behave ourselves, but not something that we can acquire by insisting upon it. In this sense, dignity is given to us by other men, and they will only give it if we do not seem to claim it. In thus defining what one thinks to be a gentleman, one does not imply that he is a saint, although, just as the greater includes the less, a perfect saint would be a perfect gentleman. In this imperfect world, however, many men may be and are gentlemen without being saints, just as there are many men advanced in sanctity whom few would label as gentlemen. As a finished product, the gentleman has the knack of seeming to do all things

easily, but that ease comes only by personal effort; likewise, he is socially secure but he was not born so, for even a king is not born socially secure. Some people think shyness or diffidence to be an attribute of the gentleman; herein lies a fallacy in that, because it is ever better to be shy than blatant, it does not follow that shyness is a virtue. A shy man may be a passive gentleman, but he is not an active one; he may be delightful if drawn out of his shell, but the active gentleman draws others out and makes them feel they are more of a success than they ever suspected. The more one thinks over it, the plainer it becomes that the gentleman is socially an artist, having acquired qualities which he himself admires for their own sake. All this is tantamount to saying that no man can become a gentleman if actuated by ulterior or selfish motives. He may get on, but his efforts to be a gentleman will only make people remark all the more that he is not one. How my dead friend would smile, if he could only see what a word-picture of him and his kind his untimely death has made me outline. One has delineated virtues which are not conventional signs of a certain class, for the virtues of the gentleman are merely those which we prize most in our ordinary relations with each other. Possibly the answer to the question, which I have attempted to give, is but the same as that which might have have been given to that other and historic question, "When Adam delved and Eve span, who was then the gentleman?"

THE INTRAVENOUS ADMINISTRATION OF QUININE BIHYDROCHLORIDE IN MALARIA, AND A REMARK UPON THE FORM OF THE PARASITE RESPONSIBLE FOR TRUE RELAPSES (WAR OFFICE INVESTIGATIONS).

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The accompanying tabular statement is of interest as supplementing the results published by Dr. John D. Thomson on the treatment of malaria with quinine bihydrochloride administered intravenously.

At the Manor War Hospital, Epsom, with the approval of Sir Ronald Ross, and in collaboration with Major J. B. Stephens, R.A.M.C., I selected for this mode of treatment certain patients in whom vigorous courses of quinine treatment, by the mouth and intramuscularly, had failed to prevent the recurrence of relapses, either very shortly after the cessation of the treatments, or, in one or two cases, actually during their progress. Our chief purpose was to ascertain whether, in this difficult class of case, a course of quinine given intravenously would be more effective in preventing relapses than the other modes of administering the drug.

All the patients selected had contracted the disease about eight months before the beginning of their present treatments; and, during the frequent relapses from which they suffered while in the Manor War Hospital, the parasites of benign tertian malaria were the only ones found. But the medical history sheet of one patient contains a record that malignant tertian parasites were found during his stay in another hospital.

In all cases the intravenous treatments were begun at the time of rigor while parasites were present in the peripheral blood; and in all cases it was the rule that, after the completion of the course of treatment, no quinine should be given until a new relapse of the disease occurred.

Cases in which patients received only one intravenous dose of quinine (followed as a rule by a course of oral administration) are omitted from the tabular statement; but a number of patients were treated in this manner with the chief object of ascertaining the smallest dose of quinine which, when given intravenously, would suffice to cause the disappearance from the peripheral blood

of all the asexual parasites of a given generation. Stated in general terms our experience on this point was that:—

(1) A single dose of six grains of quinine bihydrochloride given intravenously at the time of rigor caused a marked reduction, but by no means a complete disappearance, of all the asexual parasites of the generation which caused the rigor.

(2) A single dose of nine grains in the same conditions sometimes effected, but sometimes failed to effect, the complete disappearance of all the asexual parasites of the generation which caused the rigor.

(3) A single dose of fifteen grains given intravenously at the time of rigor invariably caused the disappearance of all the asexual parasites which caused the rigor; but

(4) the same dose given on the day of interval between two paroxysms did not effect a complete disappearance.

(5) When two or more generations of parasites were present, it was necessary, in order to ensure the disappearance of all asexual parasites from the peripheral blood, to repeat the intravenous dose of fifteen grains at such times as would ensure the presence of quinine in the blood while the parasites of the different generations were sporulating.

(6) As regards the rapidity with which a sufficient dose administered intravenously caused the disappearance of asexual parasites from the peripheral blood, a marked reduction in numbers was easily appreciable six hours after the administration, and disappearance was as a rule complete eighteen hours after the administration.

(7) As regards the effect upon *sexual* forms of the parasite, a single dose of fifteen grains did not appear to lessen appreciably the number present in the peripheral blood; and it will be seen from the tabular statement that, in ordinary thin films of finger blood from two patients who had received a daily dose of fifteen grains intravenously for four days, gametocytes could still be found without prolonged search.

The record of Case 10, shows that the amount of quinine bihydrochloride introduced into the vein in a single dose without ill-effect or unusual discomfort to the patient was on two occasions increased to twenty-one grains; but I agree with Dr. Thomson that in practically every case a single dose of fifteen grains is sufficient almost at once to cut short an attack, and I consider the intravenous administration of this dose to be the quickest and surest method of controlling cases in which high fever, delirium, or persistent vomiting prevent the administration of quinine by the

mouth. This, of course, is not a new finding, but a confirmation of results described in Sir Patrick Manson's text-book as having been recorded by Bacelli and other Italian workers, who apparently used the simple technique which Dr. Thomson has again so usefully proved to be free from danger and undesirable complications.

Unfortunately, however, our tabular statement shows that there is a class of case in which an intravenous dose of fifteen grains of quinine, although it stops the fever and causes most of the parasites to disappear from the peripheral blood, does not suffice, even when repeated daily for ten days, to prevent the recurrence of relapses. In Case 8, a relapse occurred eight hours after the ten-day treatment was concluded, and in Cases 5 and 6, the intervals between the end of this course of treatment and the beginning of a fresh relapse were only twelve and seven days respectively.

This note would be incomplete without brief mention of such items of information, concerning the parasite which causes these relapses, as have been gathered during a study of the cases.

So far as I can ascertain, the characters of the parasites present in these repeatedly relapsing cases do not differ in any respect from those of the benign tertian parasites present in cases which relapse less frequently; and the schizonts found during the attacks of fever are certainly as easily acted upon by quinine. But between the two classes of case there is, I think, this difference, that the former are much more heavily infested with parasites than the latter. In India, repeatedly relapsing cases of a similar nature occur, especially during epidemic years, in areas visited by what is termed "fulminant malaria," when (as one infers from Major Christophers' researches) the dose of sporozoites injected by infected anopheles is many hundred times greater than during years of ordinary prevalence. In 1908 fulminant malaria of this kind visited the Punjab, and the great abundance of parasites in the blood of European soldiers who suffered from the disease, as well as the apparent failure of large doses of quinine to prevent repeated and very frequent relapses, were usual findings.

A character common to all these repeatedly relapsing cases is the large number of forms of the parasite classed as gametocytes. Quinine, even when administered intravenously, is inoperative upon all these forms, but while some of them can be classed definitely, and at once, as male gametocytes, others as female gametocytes, there are yet others of which it is not possible to say definitely to which, if either, sex they belong. I think that what we have now to decide is whether all these are really sexual forms, or whether

Case	Dates of treatment	Dose of quinine bihydrochloride given intravenously	Immediate effect on fever and parasites	Effect in preventing relapses	Interval between the end of treatment and beginning of relapse	Remarks
1	May 10 to 12 ..	6 grains on each of 3 days	Fever ceased from first day of treatment. Parasites much reduced in numbers, but could still be found until the fourth day	Patient remained free from fever for 7 days, but free from parasites for only 2 days	3 days ..	The treatment was begun on the third day of an attack, when the parasites numbered 130 in 50 fields of the microscope
2	May 4 and 5 ..	6 grains on the first day, 15 grains on the second	Fever ceased from the first day. Parasites could not be found after the second day	Patient remained free from fever for 9 days and free from parasites for 12 days	8 ,, ..	The treatment was begun on the sixth day of an attack, when three generations of parasites were present
3	May 8 and 9 ..	6 grains on the first day, 15 grains on the second	Fever ceased from the first day. Parasites could not be found after the second day	Patient remained free from fever for 12 days, but free from parasites for only 11 days	11 ,, ..	The treatment was begun on the seventh day of an attack, when parasites were numerous
4	June 11 and 12	15 grains on each of the 2 days	Both fever and parasites disappeared from the first day	Patient remained free from fever for 17 days, but free from parasites for only 16 days	15 ,, ..	The treatment was begun on the third day of an attack. Parasites were scanty
5	May 22 to 31 ..	15 grains on each of the 10 days	Fever ceased from the first day. Parasites could not be found after the second day	Patient remained free from fever for 25 days, but free from parasites for only 20 days	12 ,, ..	The treatment was begun on the fourth day of an attack, when the parasites numbered 12 in 50 fields
6	May 20 to 30 ..	On the first day a dose of 6 grains at 10 a.m. and a dose of 15 grains at 4 p.m. On each of the following 10 days a dose of 15 grains	Fever ceased from the second day. Parasites could not be found after the third day	Patient remained free from fever for 16 days, but free from parasites for only 15 days	7 ,, ..	The treatment was begun on the second day of a severe attack, when parasites were numerous

7	May 20 to 30 ..	On each of the first 2 days 6 grains. On each of the following 9 days 15 grains	Fever ceased from the second day. Parasites could not be found after the fourth day	Patient remained free from fever and parasites throughout his subsequent stay in hospital, but relapsed 10 days after return to duty	56 days ..	The treatment was begun on the eighth day of an attack, when many parasites were present
8	May 22 to 31 ..	15 grains on each of the 10 days	Fever ceased from the first day. Parasites could not be found after the third day	Patient remained free from fever for only 8 days, which means that he began a relapse on the last day of the treatment. During this relapse parasites could not be found in the peripheral blood, but a few forms resembling macrogametocytes were found in films of splenic blood; and ordinary asexual forms appeared again in the peripheral blood during a subsequent relapse some weeks later	0 ,, ..	The treatment was begun on the seventh day of an attack, when two generations of parasites were present
9	June 19 to 25 ..	On each of the first 3 days 15 grains at 12 noon, and on the same days 15 grains of the sulphate by the mouth at 12 midnight. On each of the following 5 days 30 grains of the sulphate by the mouth	Fever ceased from the second day. Parasites could not be found after the fourth day	Up to the present date, which is 42 days from the end of the treatment, this patient has remained free from fever and parasites	Not relapsed yet	The treatment was begun during a severe attack with numerous parasites
10	July 8 to 12 ..	On the first day 15 grains; on the second 18 grains; on the third day 21 grains; on the fourth day 21 grains. On the fifth day a dose of 30 centigrammes of "galyl" intravenously	Fever ceased and parasites disappeared from the first day	Patient remained free from fever 9 days. Parasites were not found, as quinine treatment by the mouth was almost at once resumed	4 days ..	In this case parasites were scanty in the peripheral blood. Severe malarial neuralgia from which the patient suffered was markedly improved by the treatment

some of them may be the asexual quinine-resisting "latent" form of the parasite, which has eluded particular mention and description, because its appearance closely resembles that of the gametocyte. We have only to make this assumption in order to explain very simply both the recurrence of relapses and the appearances, as of parthenogenesis, in some crescents and benign tertian so-called sexual forms. The following observations on the present series of cases seem to show that this assumption is not unreasonable:—

(1) In instances of true relapse, as distinguished from recrudescence, the first forms of the parasite present in the peripheral blood are large forms which, if seen during the course of an ordinary attack, would certainly be classed as gametocytes, though it might not be easy to say definitely to which sex they belong. These forms, and the pre-sporulating forms which follow them, are found before the patient has any symptoms, or is aware that an attack is impending.

(2) In cases which relapse during, or very shortly after, vigorous quinine treatment by the mouth or intravenously, prolonged search of the peripheral blood may fail to show the presence of parasites, but examination of films of splenic blood may reveal, as if "encysted" in dehæmoglobinized red blood corpuscles, (*a*) large forms resembling gametocytes with a voluminous nucleus; (*b*) similar forms with the nucleus divided into three or more separate blocks.

These are persistent forms upon which quinine given intravenously is inoperative, and, failing a better explanation, one assumes that they are the cause of the relapses, and that they are not gametocytes, but are asexual form in which the parasite lays up during the intervals between true relapses.

METHODS EMPLOYED IN THE X-RAY DEPARTMENT OF A MILITARY HOSPITAL, WITH A FEW NOTES ON ONE OR TWO CASES OF INTEREST, AND ON THE TREATMENT OF TRENCH FOOT ADOPTED THERE.

By RUSSELL J. REYNOLDS, M.B., B.S.

Medical Officer in Charge of the X-ray, Electrical and Massage Departments of a Military Hospital.

It is impossible to give anything like an adequate résumé of the work undertaken in the X-ray department of a military hospital in a short article, owing to the very wide field covered, both the medical and surgical sides claiming attention.

A fair proportion of cases are from the medical side, many from the wards devoted to pulmonary tuberculosis. Of the chest cases one may mention, tubercular infections, bronchiectasis, peribronchial fibrosis, silicosis, affections of the pleura, etc., also certain heart and alimentary conditions, require examination, and occasionally cases come for treatment by the rays.

As it is impossible to enter into these at all here, I will confine my remarks to a few special points of interest among the surgical cases, and I propose to give the methods of localization which we employ, and the class of case to which each method is most suitable, together with a few remarks on the value of stereoscopic radiography.

It is necessary to state that practically all the work is carried out by the use of a couch where the X-ray tube is placed below the patient under the couch, as this method lends itself better for screening and localizing than where the tube is placed above the patient, and it is equally good for obtaining a radiograph.

The upright tube stand is only employed where it is impossible to obtain the result with the patient lying down, for example, in examining a stomach after a bismuth meal.

LOCALIZATION.

In order to obtain accurate localization of an object, it is necessary to be sure that the X-ray tube is correctly centred so that the position of the central ray is known, and to ensure that this shall pass vertically through the object to be localized.

Couches are therefore made with a tube box underneath running on a carrier having both a longitudinal and transverse movement in relation to the couch, and in order to enable one to fix the position of the central ray many devices are used.

The most simple and satisfactory in working is as follows: an upright arm is rigidly fixed to the tube box carrier and moves with it; this runs up by the side of the couch and carries a horizontal arm adjustable in height, and hinged so that it can be put out of the way; the horizontal arm is slightly adjustable in length and has cross wires fixed at the end which can be placed vertically over the anticathode of the tube, i.e., in a line with the central ray.

Localization by Method of Right-angle Planes.—In many cases of fracture or where a foreign body is present in a limb, after a preliminary screening of the part, it is frequently only necessary to take two photographs at right angles to enable the surgeon to judge of the condition. When the fracture is much comminuted, or when it is compound and comminuted, it is often of greater assistance if a stereoscopic radiograph is obtained, as it is easier to judge of the position of the fragments.

Localization by a Screening Method.—Sometimes where a foreign body is present in the limb, e.g., a small piece of shrapnel or bullet casing, it is localized either by the method of right angle planes mentioned above, or by some screening method. In the one I generally employ, a lead pointer is placed over the shadow of the foreign body when the central ray is vertically below, and the skin is marked on the spot, the depth then being obtained by placing the pointer on the skin at the side of the limb *opposite* the shadow of the foreign body, and shifting it vertically until the shadows of the foreign body and the pointer move together on the X-ray tube being moved under the part examined.

Localization by a Calculating Method.—In dealing with cases of fracture or gunshot wounds where localization is necessary in such situations as the chest, abdomen and pelvis, the methods mentioned above are seldom applicable, owing to the difficulty of obtaining radiographs in these regions at right angles to each other. It is then that one has to resort to a method where calculation is employed. I prefer the Mackenzie Davidson method, as it is quick, simple in working and accurate.

If the foreign body is in a position to be easily extracted, and in cases where it is unnecessary to obtain a stereoscopic radiograph, one plate only need be used. Screen examination is made and the rays centred, a mark is placed on the skin over the shadow of the body, the X-ray tube is then moved three centimetres in one direction and the first exposure is made, the plate is left in position and the tube moved six centimetres in the opposite direction and the second exposure made; in this way a double image of the foreign body is obtained on the one plate. It will be seen that the central

ray has shifted six centimetres between the two exposures, three centimetres each side of the vertical line. The depth of the foreign body from the mark on the skin is then very quickly found by measuring the distance between a corresponding point on the two shadows and by applying the following formula :—

$$h = \frac{a}{a + b} \times H$$

Where a = foreign body shift.
b = tube shift.
h = depth required.
H = distance of plate from anticathode.

Localization by a Method of Calculation combined with Stereoscopy.—In more complicated cases it is sometimes necessary to combine a calculating method with stereoscopy, as it enables one to form a mental picture of the position and direction of the body when viewing the negatives in the stereoscope. Stereoscopy cannot in any way take the place of accurate localization, but it forms a valuable adjunct to it.

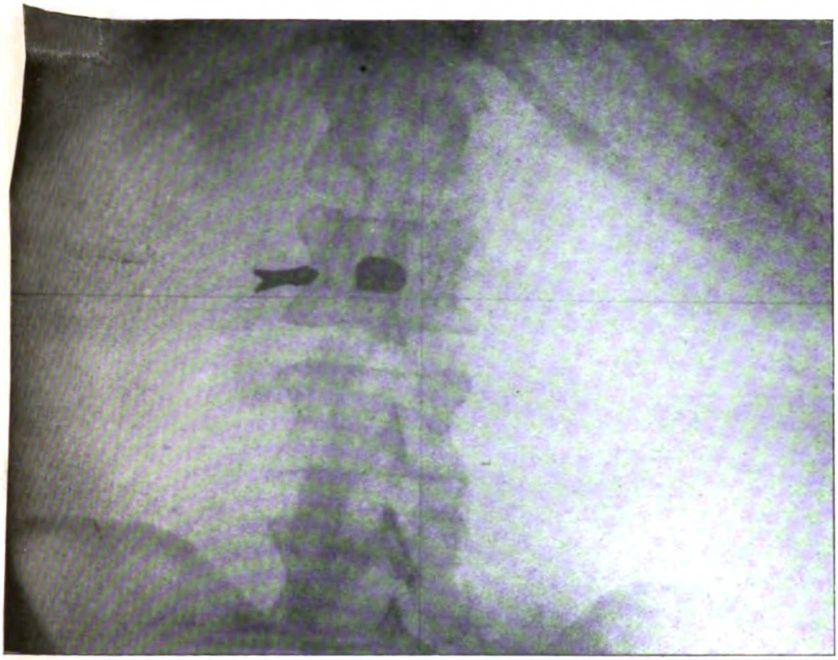
The method adopted in obtaining a stereoscopic radiograph is very similar to that described above, with a notable exception that each exposure is made on a separate plate and the position of the central ray is recorded by means of cross wires. This is accomplished by fixing a plate-holder over the part to be examined with cross wires attached to its under surface, and each plate is placed in the holder in turn; the essential point being that the position of the cross wires must be fixed in relation to the patient.

It may be of interest to give a case which illustrates the value of this method.

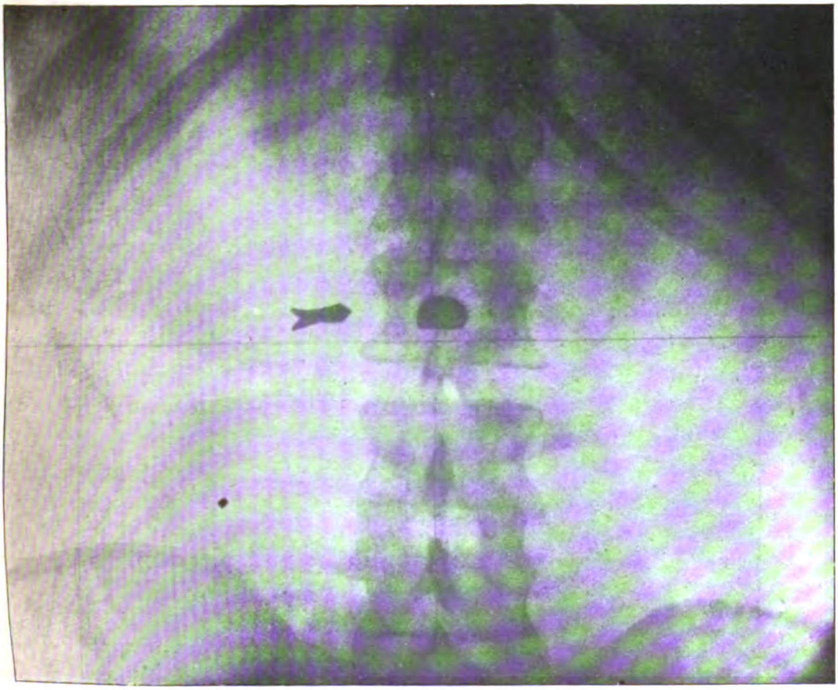
Case 1.—A man was admitted suffering from paraplegia extending from the lumbar region, and had an entrance wound to the left side of the middle line opposite the second lumbar vertebra (see figs. 1 and 2). Diagnosis was made of pressure on or severance of the spinal cord. The man was examined by the rays and a piece of shrapnel was seen to be lying either in, or on, the left side of the second lumbar vertebra and measuring about 1½ by 1 centimetre. On calculating out the depth one found it to be 5·3 centimetres in from the mark on the skin, but it was impossible to see its *exact* position; on examining the plates in the stereoscope, however, one could clearly see that the piece was lying deep to the vertebral arch yet superficial to the body. One could not say with certainty whether it was dorsal or ventral to the spinal cord itself; as there seemed to be signs of returning power to the patient's sphincters, it was thought that the man's symptoms might be caused by

pressure on the cord which could be relieved by an operation and it was hoped that the cord might not be severed. It was therefore decided to operate. Mr. E. Gillespie performed a laminectomy and it was found that the shrapnel had penetrated the pedicle and carried a fragment of bone through the cord. The piece of shrapnel was lying just embedded in the body of the second lumbar vertebra; it was not taken out as no good object could have been attained. The patient was suffering from cystitis and subsequently developed pyelitis from which he died. It will be seen how essential the use of the stereoscope is in such cases, but it also points out its limitations, in that one is not able to locate the foreign body by a visual method with absolute accuracy.

Case 2 (figs. 1 and 2).—A case which perhaps deserves to be mentioned is that of a man who had two small pieces of shrapnel in the wall of the heart without causing him any inconvenience. This man, a New Zealander, was wounded in August, 1915, he had a portion of his fractured third rib removed. He was then transferred to England. It is necessary here to give a few of the surgeon's notes on the case. "On admission his general condition was decidedly poor, there was considerable pain in his left shoulder joint, obviously reflex in origin, there was a large scar extending more or less horizontally across the precordial lesion one inch above the left nipple, and about five inches long, with a discharging sinus in the centre." The patient was sent up to be examined under the rays, and on screening his chest it was seen that he had two small pieces of metal (probably fragments of shrapnel) which appeared to be embedded in the wall of his heart. The radiograph was taken with as short an exposure as was possible at the time (three seconds) and a blurred image of the shrapnel was obtained. I then radiographed the heart from different angles, and on examining the resulting negatives the shrapnel appeared in each case to be within the shadow of the heart. It was agreed that this did not account for the man's general condition. He was then opened up by the surgeon and the underlying tissues explored. The origin of the sinus was found to be the necrosing cartilage of the third rib, which was removed. No deeper communication could be found. The wound was sewn up and completely healed in a fortnight. The man's general condition improved rapidly and his pain entirely disappeared. After he had recovered I took a further radiograph of his chest instantaneously (about one-tenth of a second) and so was able to see the pieces of metal sharply defined. The point to which I want to draw attention is that although by the instantaneous

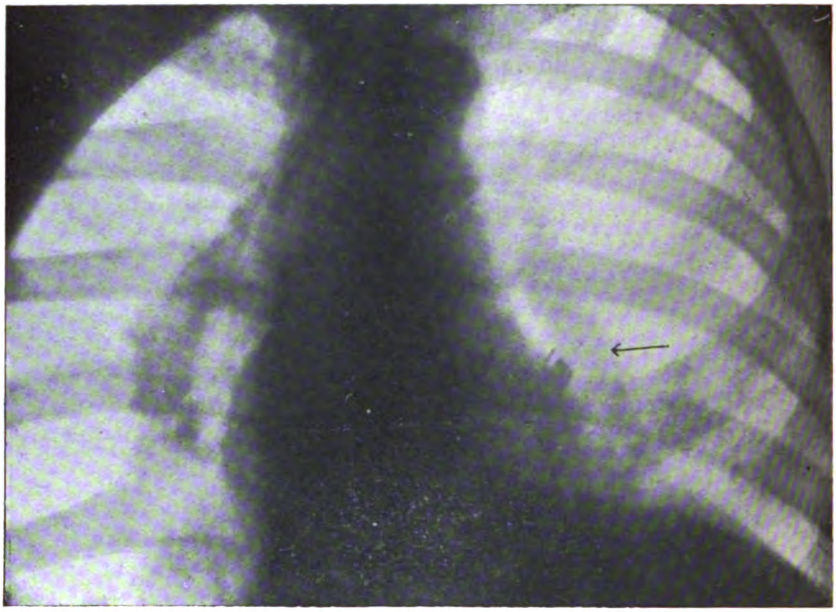


CASE 1. Fig. 1.—Stereoscopic View (Left).



CASE 1. Fig 2.—Stereoscopic View (Right).

To illustrate "Methods employed in the X-Ray Department of a Military Hospital, with a few notes on one or two Cases of Interest, and on the Treatment of Trench Foot adopted there," by RUSSELL J. REYNOLDS, M.B., B.S.



CASE 2. Fig. 1.—Exposure 3 seconds.

CASE 2. Fig. 2.—Exposure $\frac{1}{10}$ second.

To illustrate "Methods employed in the X-Ray Department of a Military Hospital, with a few notes on one or two Cases of Interest, and on the Treatment of Trench Foot adopted there," by RUSSELL J. REYNOLDS, M.B., B.S.

method a clearer image was obtained, yet *without* the time exposure it would have been difficult to diagnose these pieces as being in the ventricular wall, as the blurred image clearly shows the extent and direction of the movement.

The foregoing case affords a very good illustration of a condition which is occasionally met with when it is exceedingly difficult to localize with any accuracy the position of a foreign body. The heart being a continually moving organ, any localization attempted by calculating methods could only be very approximate, and, to obtain a good stereoscopic effect, it would be necessary to take radiographs instantaneously in the same phase of its best.

In conclusion, one may say that experience teaches that no one particular method of localization is applicable to every case, and each case must be dealt with according to its merits.

Telephone Probe.—As an accessory instrument I should like to mention Sir James Mackenzie Davidson's Telephone Bullet Detector. This has proved very valuable on occasions by definitely fixing the position of metallic foreign bodies at the time of the operation. There are two classes of case which mainly call for its use.

(*a*) Where the shrapnel lies embedded in some thick mass of tissue, such as the buttock, where directly the surgeon makes an incision his landmarks are lost owing to the mobility of the part. Here if a sharp probe is inserted to the required depth, and the foreign body hit upon, it becomes an easier matter for the surgeon to extract it.

(*b*) Where a *small* piece of metal is embedded in the tissue, it is exceeding difficult for the surgeon to feel it, even although he may be actually holding it in the fingers. Instances such as these are continually occurring. When the muscle is explored by the needle attached to the instrument, the characteristic sound will be heard in the telephone when the metal is touched.

A modification of the ordinary method suggests itself of adapting three separate probes to the one pole of the instrument, each of which is inserted in the tissues from a different angle in seeking the foreign body, and these can then be held in position by light clips attached to a central support. It is just worth while to mention that a sharp probe cannot be employed with safety in a region where large blood vessels exist.

TREATMENT OF TRENCH FOOT.

So much has been written on the subject of trench foot recently that it seems unnecessary to describe the condition here in detail.

It certainly differs from so-called "frost-bite" in many important details. The essential factors which set up the condition seem to be that the patient remains in a wet sodden situation for a considerable period with his feet kept constantly wet, the temperature being at the time low, but not necessarily down to freezing point. The cardinal symptoms presented are pain in the foot and swelling, often with discoloration of the skin, occasional numbness and tingling. Sometimes, however, the feet exhibit hyperæsthesia. They are nearly always cold to the touch, and in severe cases ulceration has occurred, and even portions of the tissues may have separated, a gangrenous condition having set in.

Treatment.—Many forms of treatment have been suggested and carried out. So encouraging have been the results obtained here by the use of Dowsing heat baths, combined with massage, that at present all our cases are treated in this way. Where there is an ulcerated surface or open wound, the part is *well* protected with fire-proof lint sheets, and the heat applied gradually. This applies also to cases where the part is anæsthetic, as blistering of the skin may be set up very easily. Where the foot is hypersensitive, very gentle effleurage is undertaken at first, or this may even be postponed for a week or so. In an average case the Dowsing heat baths are given daily for twenty minutes, the foot in all cases being surrounded by two layers of lint sheeting. The massage is commenced after this and continued for ten minutes; effleurage with friction movements and foot rolling are given. As the condition improves, and the part becomes less sensitive, more stimulating movements are adopted. The average length of a course is about three weeks. Of these cases we have treated about fifty-five per cent have recovered sufficiently in this time to omit treatment, the feet appearing normal, and the patients are free from pain and able to walk well.

It is very important to insist upon the patient keeping his feet up and resting them during the earlier stages of the treatment. It seems preferable to let them use their feet in moderation as soon as they are free from pain and the swelling has subsided, even though they may still complain of a burning sensation and some pain in the night, as by so doing the circulation is stimulated; if, however, they are on their feet too much progress towards recovery is retarded and the pain and swelling may return.

I wish to thank Major McDowell, C.M.G., R.A.M.C., for permission to publish the cases mentioned in this article.

Clinical and other Notes.

ARRANGEMENT FOR HEATING DRYING ROOM FROM INCINERATOR.

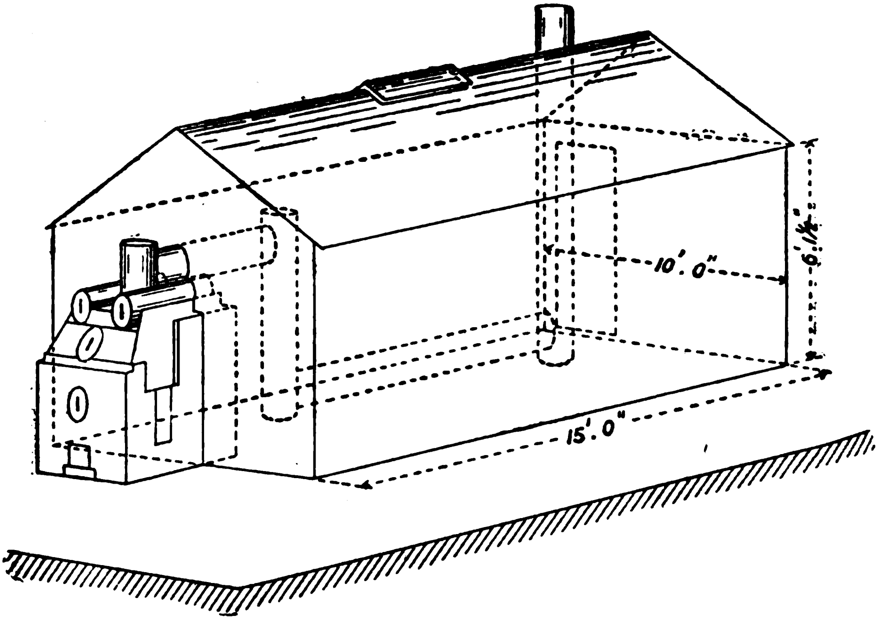
By Lieutenant-Colonel J. MACKINNON, D.S.O.
Royal Army Medical Corps (Territorial Force).

In the Journal of the Royal Army Medical Corps for March, 1917, is a short description of a simple form of incinerator for burning excreta. Fourteen months' experience of this type of incinerator has confirmed the opinions originally formed of its serviceableness and efficiency. One of its chief features is the large quantity of material it can dispose of without any offensive smell. This is accounted for by the intense heat generated, which is sufficient to melt glass.

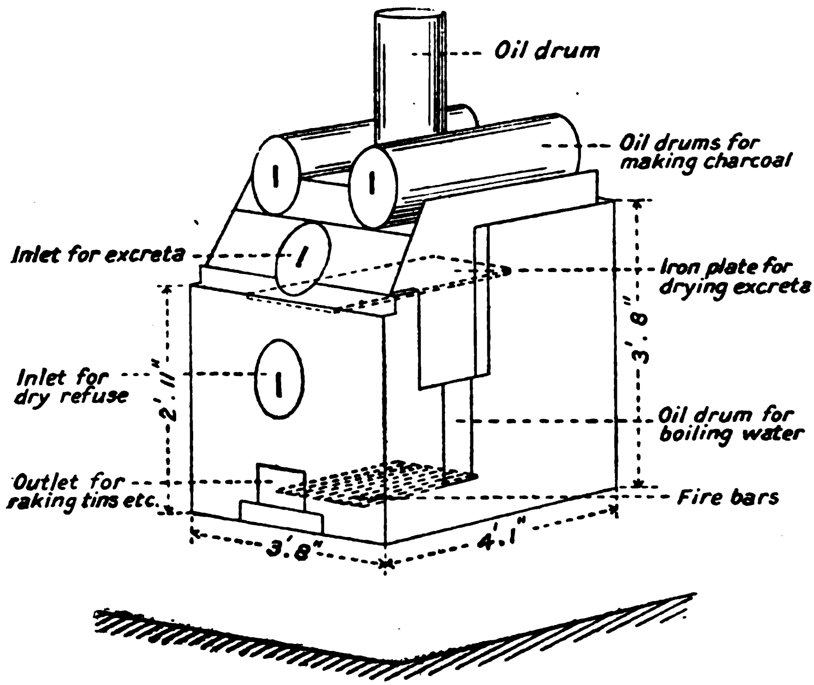
Slight modifications of the original type have been introduced from time to time. By building oil drums inside the body of the incinerator, urine can be successfully evaporated. One hundred and ten gallons of urine have been boiled off in one day from one of these incinerators.

In the autumn of 1916 a scheme was adopted in this ambulance for utilizing the heat from the incinerator for drying room purposes. The accompanying sketch shows at a glance how it was accomplished. The incinerator is built first. The drying room is then erected so that the posterior wall of the incinerator projects slightly into it at one end. A long chimney, built by fitting oil drums together, and taking a rectangular course, is then constructed, and fixed to the ordinary chimney of the incinerator, as shown in the sketch. The oil drum resting on the top of the incinerator is closed at its upper end. The chimney, when fitted, passes through the end wall of the drying room, then downwards to within six inches of the floor, along the middle of the hut towards the other end, and then directly upwards through the roof. There is no difficulty in getting the incinerator to start burning, as might be imagined with such a long chimney, and so many angles, and the draught is very strong.

The drying room is 15 feet long, 10 feet wide, and 6½ feet high to the eaves. Timber not being readily obtainable, the walls were constructed of mud, with which was mixed a little chaff for binding. When the frame of the drying room had been built, two layers of wire netting were nailed, one on the outer side and one on the inner side. These layers were therefore about three inches apart, and served as a support for the mud, which was puddled between them. The roof was made of boarding covered with tarred felt. A small ventilator was fitted to the roof. The entrance to the drying room is at the end opposite to the incinerator. It



Arrangement of Incinerator and Drying Shed Combined.



Detail of Incinerator.

is important to have a small closed porch built over the entrance, so that the door of the drying room does not open directly to the cold air. The porch is fitted with a window, and serves as a store-room and office for the orderly-in-charge. The porch is not shown in the sketch. A clothes-rail is built along each side, and over the top of the chimney in the drying room.

The heat generated by this arrangement is greater than I have experienced in any other drying rooms I have tried or seen in use.

The advantages claimed for this system are:—

(1) Efficiency. The heat developed in the drying room is very great, and a large number of articles can be rapidly dried.

(2) Economy. The heat is produced entirely by the incineration of refuse. The drying room is also built on economical lines.

(3) Simplicity of construction.

(4) Absence of smoke or smell in the drying room.

It might be thought that as an incinerator cannot be kept always in action, the lack of continuity in the supply of heat might prove a considerable disadvantage. That has not been found so from experience. This type of drying room has been in use by this ambulance during the past winter, and has been found to work most admirably, and to meet all our requirements.

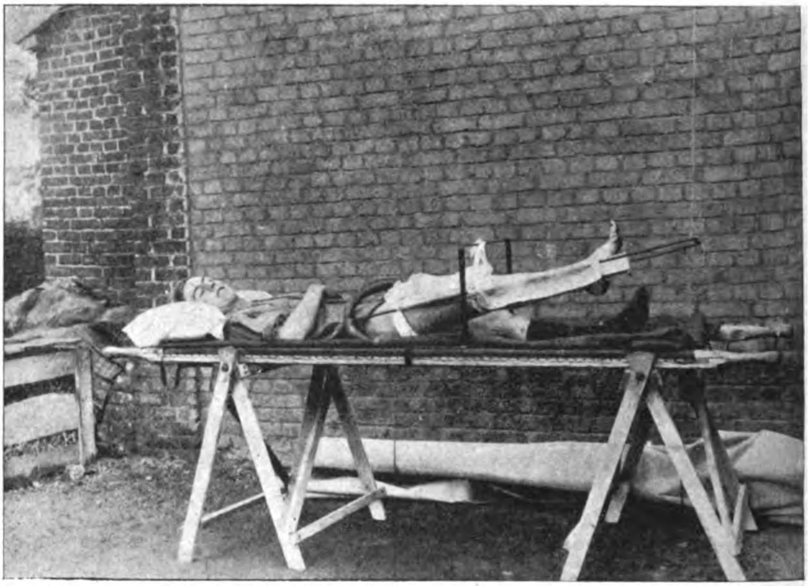
To Lieutenant and Quartermaster E. T. Jones lies the credit of originating this type of incinerator. The two orderlies in charge have been responsible for working out the details of construction.

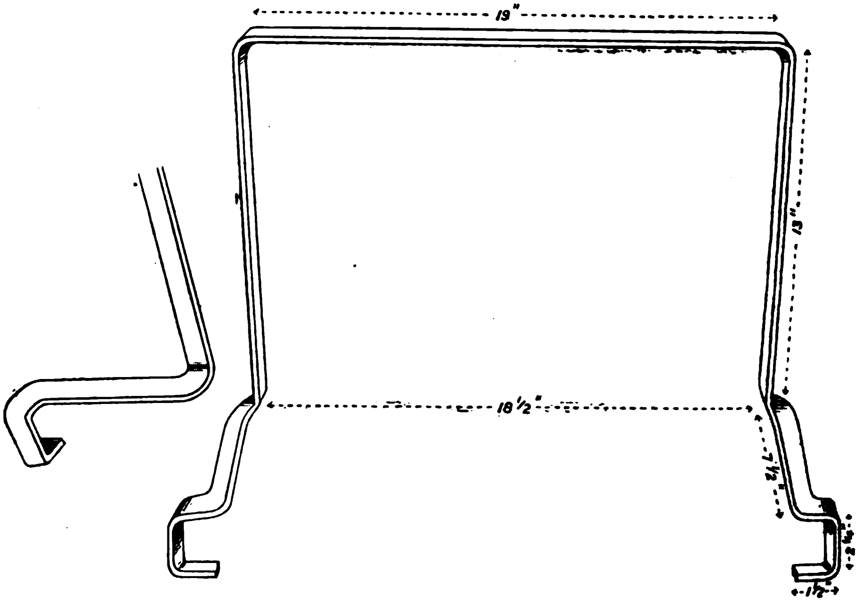
A DEVICE FOR SUSPENDING FRACTURED LIMBS DURING TRANSPORT.

By Captain OWEN RICHARDS.
Royal Army Medical Corps.

In June, 1915, Col. Cuthbert Wallace, A.M.S., suggested to me that there was a need of some device for this purpose. No. VIII. M.A.C. very kindly made one to my design in their workshops, and Colonel Wallace had copies of it made at the base. It is now extensively used in this and other armies in France, and would probably be found equally useful elsewhere.

The material is iron bar, ¾ inch by ¼ inch, and the dimensions and design can be seen from the accompanying diagram, for which I am indebted to Capt. Timpson, R.A.M.C. The elasticity of the arch allows it to be readily sprung open and clipped on to any part of the regulation stretcher, and when in position it is quite rigid to any strain applied from below. A stretcher thus fitted will go into the upper tier of any ambulance car; in some types it will also go in the lower, but not in all.




19"
13"
18½"
7½"
2¼"
1½"

This point is not of much importance, as cases requiring suspension form a very small proportion of the total lying cases.

It is commonly used for fractures of the thigh in a Thomas' splint, but it also serves for fractures of the humerus in a Thomas' arm splint. The material is cheap and easily obtained, and the work can be done by any smith.

NOTES ON THREE CASES OF LIGATURE OF THE COMMON CAROTID ARTERY AT A CASUALTY CLEARING STATION.

By Captain J. J. M. SHAW.
Royal Army Medical Corps (*S.R.*).

In those cases of injury to the large vessels of the neck which escape death upon the field from primary hæmorrhage, operative treatment is seldom called for before the patient reaches a base hospital. The conditions usually presented at a Casualty Clearing Station are either a small deep traumatic aneurysm or, more commonly, an arteriovenous aneurysm of variable size, while, in a few rare cases of severe reactionary or secondary hæmorrhage, ligation may be indicated.

An aneurysm which is increasing in size or is dangerously superficial in the neighbourhood of the wound may necessitate early operation, but all other cases are best treated by rest and observation. At the end of fourteen days, if the tumour be stationary or decreasing in size, they may be transferred to the base, where spontaneous cure will sometimes occur after several weeks, or operation can be performed when the limit of diminution is reached.

An aneurysm existing for even a few hours is the best preparation for ligature, owing to the fact that the collateral circulation is gradually and not suddenly called upon to supply the area of deprivation, and can adequately cope with the requirements of the tissues when complete cessation of supply through the original channels is effected. This is well exemplified in the case of the popliteal artery where severance of the vessel by a bullet, even without much loss of blood, almost invariably leads to gangrene of the leg, while ligature for traumatic aneurysm very seldom does so; the Letouffier tube aims at the performance of this function of an aneurysm in the provision of a modified supply of blood, while the critical period of collateral expansion is tided over.

During thirty months in a Casualty Clearing Station, amongst a total of 44,000 wounded, I have seen only three cases in which ligature of the common carotid appeared to be indicated, each for one of the three conditions enumerated above—severe secondary hæmorrhage, dangerously superficial aneurysm, and a tumour which increased in size despite rest in bed.

Pte. M. was wounded on December 28, 1914, by a rifle bullet, which entered the neck posteriorly at the level of the fourth cervical vertebra and one inch from the middle line on the left side. The ascending ramus of the lower jaw and the alveolus of the upper on the left side were shattered. The malar bone was fractured but not comminuted, and the whole cheek from mouth to ear was torn in shreds. He was in a state of collapse, and much ensanguinated when admitted to a Casualty Clearing Station eight hours after being wounded. An intravenous saline, containing two drachms of brandy, was administered, and this, combined with warmth, gave rise to a severe reactionary hæmorrhage. The large gauze plugs in the wound were quickly withdrawn and, aided by the patient fainting, several large fragments of bone and loose groups of teeth were removed. No bleeding points were secured, but a ligature was applied to the twisted end of the facial artery, which lay free in the wound. Packing sufficed to arrest the welling up of blood from the deeper parts at the time, but on the following morning another severe hæmorrhage occurred, and, under an anæsthetic, I tied the external carotid through an incision extending from the wound.

For four days there was no further hæmorrhage, but the wound became extremely septic, and the fœtor, associated with large wounds of the mouth, was unpleasantly pronounced. On the fifth day a violent hæmorrhage took place while the patient was drinking some lemonade. The blood appeared to flow from the internal carotid, where ulceration of the vessel had probably occurred. He rapidly became semi-conscious, and, under a light anæsthetic, I tied the common carotid through a transverse incision. This wound was covered with gauze and collodium and remained aseptic throughout. This operation rendered him completely aphasic and hemiplegic for three days, and very dangerously ill for a week. On the fourth day he suddenly called out "Here!" and this word was used to express all his wants until the seventh day, when his vocabulary commenced to increase and, in certain moods, to intensify to a considerable degree. The first voluntary movement of the right arm and leg occurred also on the fourth day after operation. He was very irrational for about ten days, and required nasal feeding on several occasions. When transferred to the base, three weeks after the last operation, the movements of the limbs of the right side equalled those of the left in vigour, and he was cheerful and sensible, although still very weak. Five months later he wrote from Ireland to say that he was quite well except for "the extra little hole in his face."

Pte. F. was wounded on July 26, 1916, by a shell splinter, which entered the left side of the neck at the anterior border of the sterno-mastoid, immediately above the level of the cricoid.

Prior to admission to the Casualty Clearing Station fine gauze plugging had been packed into the wound and the hæmorrhage success-

fully arrested. A large superficial anteriovenous aneurysm was present, with a loud "machinery" bruit and distinct "prickly" thrill. He complained of continuous roaring noises in the head like breakers on a shore, which forbade sleep, and considerable discomfort was experienced on swallowing, or movement of the head, but no actual pain.

As the aneurysm was large and dangerously near the surface, exposing him to the risk of copious hæmorrhage on extraction of the plug, I ligatured the common carotid on the following day. No change was visible in the face on tightening of the ligature. On removal of the gauze plug from the wound, considerable venous hæmorrhage took place. The sac was freely exposed, and the veins leading thereto, including the internal jugular, were grouped together above and below and ligatured. As the hæmorrhage was thereby completely arrested, the artery which had been undisturbed at the seat of injury was not ligatured distally. The missile was not searched for. He exhibited no post-operative symptoms. The noises in the head had disappeared completely, and there was no trace of paralysis or aphasia. He was transferred to the base on the tenth day after operation, and three months later wrote to say that the missile had been extruded on October 1 through a small sinus at the seat of the original wound without operation, and he was about to have a Board with a view to a return to active service.

The third case was undertaken for an enlarging tumour, which proved to be an abscess in the laminæ of the original aneurysmal sac, and, unfortunately, ended fatally.

Pte. G. was wounded on the right side of the neck by a shell fragment on October 24, 1916. He was admitted as a walking case to Casualty Clearing Station, eight hours after being hit, with a temperature of 102° F., pulse 120. The wound was small and situated in the mid-line of the sternomastoid, immediately below the level of the cricoid. There was no external hæmorrhage after admission, but the patient said that it had bled freely at first and then stopped of its own accord. A small deep pulsating tumour could be felt; there was a distinct aneurysmal thrill, and also a bruit, which was, however, more easily audible over the temporal artery than through the fascial and muscular layers.

The tumour increased in size for two days, but caused very little discomfort, the temperature and pulse falling steadily. On the third day it was visibly smaller, and continued to decrease in size until the seventh day, when he stated that he felt "champion," and talked and ate with great gusto. On the evening of the eighth day his pulse rose from 68 to 84, and his temperature from 98·6° to 99·8° F., the swelling being slightly larger. He slept well however, and felt better the following morning. He complained of tiredness, and towards evening his respiration

appeared to be slightly interfered with. The slight irritative cough which had affected him throughout sounded harsher. On the following morning his pulse-rate had dropped from 96 to 82, temperature 99° F., and he felt again a little better, but the swelling had increased considerably towards the root of the neck, and his lips and ears showed a slight degree of cyanosis.

I decided to operate and, through a long oblique incision, first disarticulated and removed a portion of the inner end of the right clavicle in order to have ready access to the artery in the event of rupture of the sac. The common carotid was ligatured about one and a half inches above the innominate bifurcation. The tumour caused the vessels of the neck to curve outwards, while the trachea and œsophagus were pressed over to left of the middle line. The large tumour was then incised, and out flowed several ounces of creamy pus. When this had been mopped away, an inner tumour about the size of a large hen's egg became visible—the actual aneurysm. The pus cavity, developed in the intermediate laminæ of the original aneurysmal sac, surrounded the aneurysm on all sides except posteriorly, and stretched up behind the sternomastoid muscle to the mastoid bone. Two fingers could be easily passed between the œsophagus and prevertebral fascia. The aneurysmal sac was then incised and a finger placed upon the bifurcation of the carotid, immediately below which lay an oval slit about fifteen millimetres in length on the anterior aspect. The jugular vein appeared to be unwounded. A distal ligature was applied and the wound left open.

The patient never rallied from the operation, and died four hours later. The jugular vein was found to be intact, but bound down with the vagus nerve in dense inflammatory tissue. Nothing beyond a slight comparative congestion of the left cortex was observable in the brain. A smear of pus showed numerous micrococci and several organisms closely resembling *Bacillus perfringens*. The pericardium contained 152 cubic centimetres of clear fluid. The small fragments of metal lay embedded in some enlarged deep cervical glands on the left side.

The heart tires with great rapidity under even a small degree of respiratory embarrassment, due to obstruction of the air passages in the neck, whether the cause be aneurysmal or a wound of the larynx or trachea. The facts of the external wound having practically healed over the sternomastoid, the masking of the presence of the pus stratum by the deep fascia and the patient's appearance and sense of well-being until the morning of operation, appeared to justify the hope that a second diminution might occur.

Delay in operation was disastrous to this lad, and the experience of this case would lead me in future to operate at once upon an aneurysm which, having become quiescent, again commences to enlarge.

A CASE OF GUNSHOT WOUNDS OF FACE AND THIGHS; ŒDEMA OF GLOTTIS; DEATH UNDER NITROUS OXIDE ANÆSTHESIA.

By Major G. H. COLT.
Royal Army Medical Corps.

The following case is worth recording because the occurrence of acute œdema of the glottis, after a small wound of the face, has not been brought prominently before the notice of surgeons since the war began.

Pte. F., aged 33, was wounded by splinters of shell, on January 29, in the upper part of the posterior surface of each thigh and in the right side of the face. Two days later chloroform was administered and the sloughs removed from the relatively speaking small wounds of the thighs. The anæsthetic was administered without any difficulty and the operation lasted thirty minutes. The wound of the face had scabbed over and in fact the condition in this respect looked so insignificant that it was nearly left alone. On removing the scab a small piece of metal was felt and removed. It was about $\frac{3}{16}$ inch square and larger than the scab. The cavity containing it was gently curetted and a tube inserted. This wound, which led to the death of the patient five days later, was situated $\frac{1}{2}$ inch in front of and $\frac{1}{2}$ inch below the level of the tragus of the right ear. It admitted a small curette to a depth of $\frac{3}{4}$ inch. No bare bone could be felt. It contained no cloth. It did not communicate with the mouth. No bacteriological examination was made of the interior. For three days all went on satisfactorily, but on the fourth day, six days after the patient had been wounded, the right side of the face was slightly more swollen than it was the preceding day and a fomentation was applied. In the evening the swelling showed also in the neck and the temperature rose to 102° F. On the morning of the seventh day after the patient had been wounded there was marked œdema of the eyelids on the right side, and the patient complained of pain in swallowing. On examination the fauces were seen to be congested and slightly swollen, especially on the right side. At this stage it did not occur to us to examine the larynx; the matter looked simple enough, the swelling of the face and neck being due to insufficient drainage from the abscess. In point of fact two of us well used to anæsthetic work had independently noticed that there was slight respiratory obstruction; both of us had discounted it as being due to the swelling pressing on the right side of the pharynx, and both of us had mentioned the fact to the anæsthetist.

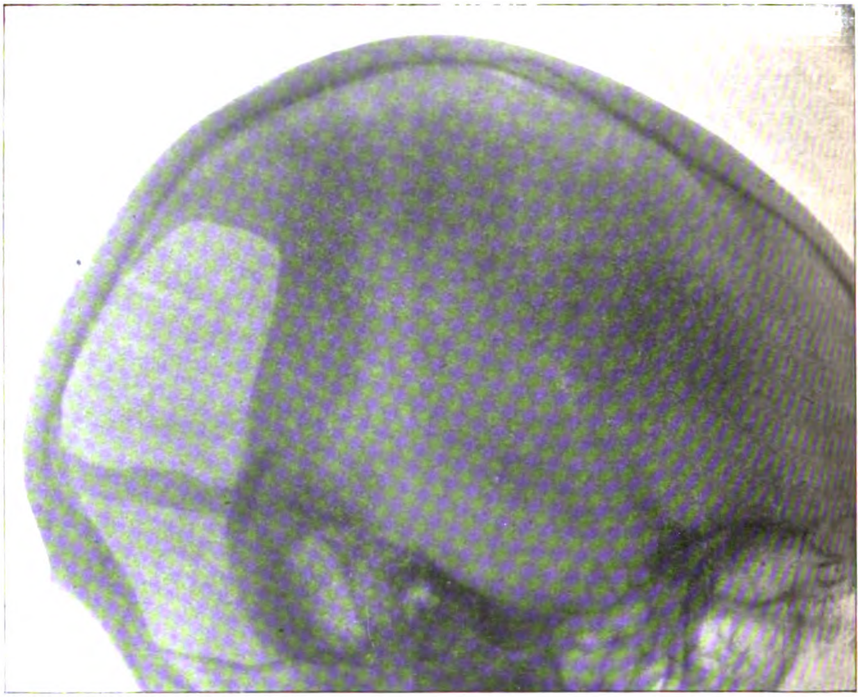
Nitrous oxide gas was administered by the non-rebreathing valve method. After six inhalations the patient became blue, the administration was stopped, the mouth opened and the tongue drawn forwards and two fingers inserted down to the epiglottis and separated. Hewitt's artificial airway was introduced; respiration continued, evidently with considerable

obstruction, for about thirty seconds. Spasmodic inspirations followed at intervals of about twenty seconds for something like two minutes, a small amount of air entering and leaving the airway. This made me hesitate to perform laryngotomy, although if such had been done at this stage life would probably have been preserved. Liquor strychninæ was given hypodermically in the pectoral region, the phrenics were faradized and hot cloths applied to the chest. No pulse could be felt in the wrist, but the heart was beating feebly. About five minutes from the start laryngotomy was performed and air then entered freely. Fifteen minutes from the start an incision was made into the abdomen through the upper part of the left rectus and the heart massaged bimanually, this and artificial respiration being continued for thirty-five minutes. The patient having shown no sign of life for half an hour they were discontinued.

Post mortem there was œdema of the fauces and glottis extending down as far as the upper border of the true vocal cords and on the right side involving also the posterior part of the true cord. The œdema was more marked on the right side than on the left and could be traced to the upper part of the right side of the soft palate near the wound. The uvula was œdematous. The rest of the organs with the exception of the spleen, which was somewhat enlarged, were healthy and normal. The thymus was not enlarged.

It seems to me that an immediate laryngotomy following on the onset of obstruction to breathing would have saved this patient's life for the time being, and that it was the only course to have adopted. Laryngotomy is undoubtedly the operation of choice in such a case, for one only requires for its performance a knife and a pair of short pointed scissors, or even a knife alone. The operation seldom takes longer than twenty seconds to perform. The method of drawing forward the skin and transfixing it transversely with the knife, whereby the vessels on the crico-thyroid membrane are left behind uninjured, deserves to be more widely known than it is. The membrane being perforated with the points of the scissors and their blades being then separated the vessels are pressed to each side and hæmorrhage is reduced to a minimum. In the case of a patient with a short, thick, congested neck, for instance a child who has tried to drink hot water from a kettle, this absence of bleeding is a great help. In the case referred to it is probable that laryngotomy would have been needed in a short space of time whether an anæsthetic had been given or not, in fact the next time that the patient fell asleep.

Particular attention should be drawn to the danger of the onset of œdema of the glottis following a wound in the parotid region. Such œdema is well known to occur in cases of facial anthrax, especially when the pustule is situated near the angle of the jaw, and in cases of wounds of the mucous membrane, notably after extraction of an impacted and septic wisdom tooth. Not having access at the present time to the



To illustrate "A Case of Gunshot Wound of Head," by GERALD SICHEL, F.R.C.S., Major R.A.M.C.

literature of the subject I cannot state the relative frequency of its occurrence in these conditions.

The proposed operation, which was the immediate precursor of death, could have been efficiently and quickly performed without any anæsthetic but this would have been a painful proceeding.

A CASE OF GUNSHOT WOUND OF HEAD.

By Major GERALD SICHEL.

Royal Army Medical Corps; Chief Surgeon, The Lord Derby War Hospital, Warrington.

Cpl. T. L. was wounded on January 6, 1916, when leaving Cape H., by a piece of shell. He was hit in the right posterior parietal region. He was operated on at M. and a foreign body removed. He was blind for twenty-one days after being wounded, but gradually regained his sight.

When he landed in England on February 27 there was still a discharging wound. This was healed by May when he was invalided and sent home.

On January 31, 1917, he was sent to this hospital for operation.

On February 17 he was operated on, hæmorrhage being controlled by a piece of rubber tubing round the skull, a large horse-shoe shaped flap of scalp and periosteum was turned down, in the process of doing which a small opening into the adherent dura mater was made accidentally but at once sewn up with catgut. An aluminium plate 4½ inches in diameter was then adapted to the contour of the skull about a large square area of bone which was entirely missing, about 2½ inches square. The lower part of the disk was cut off to fit it to the origin of the occipital part of the occipita frontalis muscle, and the flap replaced and sewn up with a continuous catgut suture. He made an almost uneventful recovery. There was at first a great deal of tense bulging over the operation area, and on two occasions twitchings of the hands were noted. His temperature assumed a hectic type from February 20 to 25, its highest point being 101·4° F. on the evening of February 21, but it gradually returned to, and has remained, normal.

Patient is quite comfortable in every way. I thought the case worth recording as showing what a large disk of metal can be tolerated by the tissues.

My thanks are due to Lieutenant J. W. Miller, R.A.M.C., for his notes on the case, and to Captain W. H. Hooton, R.A.M.C., for the X-ray photographs. The disk being aluminium does not come out very dark.

AN ACCOUNT OF TWENTY CASES TREATED BY HYPNOTIC SUGGESTION.

By Lieutenant J. B. TOMBLESON.
Royal Army Medical Corps.

I am writing an account of the following twenty cases to demonstrate the very good results achieved by this form of treatment, the variety of cases which are amenable to treatment, and the saving of time which results from its use.

I will give a short account of each case, reserving the discussion on the subject till the end of this paper.

Case 1.—No. 24105 Pte. B., aged 24. Diagnosis, neurasthenia. Sent by Colonel Purves Stewart, C.B., A.M.S. March 11, 1916: Admitted suffering from (1) severe vertical headache; (2) analgesia all over, more definite on the right side (patient is left handed); (3) loss of senses of smell and taste, more definite on the right side; (4) weakness of right leg with dragging of foot from old trench foot; (5) sleeplessness. March 12, 1916: Hypnotic state (hereafter styled Hyp.) third stage reached. No result from suggestions. March 13, 1916: Third stage reached. No result from suggestions. March 14, 1916: Hyp. somnambulism (hereafter styled Som.) reached. Suggestion given for relief of headache. March 15, 1916: Headache much relieved. Hyp. som. Suggestion repeated. March 16, 1916: Headache gone. General condition much improved. Suggested disappearance of analgesia, under som., and made the patient walk about the ward without a limp, and without dragging the right foot, which he did. March 17, 1916: Analgesia much less marked. Hyp. som. Suggestions repeated. March 18, 1916: Patient states that "I am quite well," and on examination such is apparently the case, except that his taste is not quite normal on the right side. Hyp. som. Suggested that cure is perfect, including sense of taste. March 25, 1916: Taste still not quite perfect, otherwise apparently quite well. Hyp. som. Suggestions *re* taste renewed. March 26, 1916: Taste perfect.

Case 2.—No. 16741 Pte. K., aged 18. Diagnosis, Jacksonian epilepsy, with marked functional gait. Sent by Colonel Purves Stewart, C.B., A.M.S. March 22, 1916: Admitted suffering from fits (two on 21st, two on 20th and several earlier), tremor of limbs, especially on voluntary movement, with much pain, cannot stand, increased patellar reflex. History of a fall into a harbour at age of 7, followed by a week's unconsciousness, with bleeding from nose and ears; this was followed by fits marked by unconsciousness and convulsions of right face, arm and leg, which recurred constantly till the age of 12, when they stopped. Had cerebrospinal fever five months ago. Had pneumonia at Salonika in February. March 23 and 24, 1916: Hyp., third stage. No result from

suggestions. March 25, 1916: Had two fits last night. Hyp. som. aura of "funny feeling in right big toe" elicited and inhibited. March 26 and 27, 1916: Patient can now walk with typical functional gait. Hyp. som. Suggestions repeated. March 28, 1916: Patient had two fits last night, and explained under hyp. som. that he had got round the inhibition of the aura. April 3, 1916: Two fits last night. April 5, 1916: Hyp. som. to last three days. During night of April 6, 1916, restless for an hour with some twitching of right face, but no fit. April 8, 1916: Woke feeling well. Hyp. som. to last two days, but two hours later a fit started and was stopped at once by suggestion, but patient woke. Left him awake for the rest of the day. April 9, 1916: Hyp. som. Suggestions repeated. Sleep to last for two days. April 10, 1916: Still deep; during the last evening a small beginning of fit stopped at once by suggestion. April 11, 1916: Patient woke this morning and had another small beginning, which was stopped as usual. After this patient had no more fits at all, his functional gait has entirely disappeared and he is apparently quite well (May 12, 1916).

Case 3.—No. 952443 Pte. K., aged 22. Diagnosis, hyperthyroidism. Selected by Colonel Garrod, C.M.G., A.M.S. April 3, 1916: Admitted suffering from typical hyperthyroidism, tremor of hands, enlarged thyroid, pulse 120, blood pressure 136-40 with a hæmic murmur. This case, like all the cases of hyperthyroidism which I have treated, needs no detailed description; I induced deep som. at the first sitting and suggested increased nerve strength and steadiness, and repeated this with an occasional addition of lessening of the thyroid for ten days, when the patient declared himself quite well and appeared on examination to be so.

Case 4.—No. 20747 Pte. S., aged 21. Diagnosis, psychasthenia. Admitted March 24, 1916, in stuperose condition, unable to move or speak, eyes fixed in a position of extreme internal strabismus, legs fixed in a position of over-extension and quite immovable: condition very similar to catalepsy. As the patient was quite unable to give me any attention, I could not hypnotize him by any of the ordinary methods, and after many failures to get any result, at length one day while hypnotizing the man in the next bed I thought that his expression altered, showing that he was listening, and at once I gave him some suggestions on general improvement. This was on March 30, 1916, and from this time he steadily improved. March 31, 1916: Patient spoke a few words, and looked more cheerful. April 5, 1916: Patient sat up in bed and ate his tea, and after tea read a book of his own accord. April 9, 1916: Patient sat up for an hour and walked about the ward. April 11, 1916: Patient left the ward and strolled about the hospital, would not go to bed till 9 p.m. From this point patient very rapidly became normal.

Case 5.—No. 10077 Pte. H., aged 32. Diagnosis, psychasthenia.

Sent by Colonel Purves Stewart. April 5, 1916: Admitted suffering from severe pains of a stabbing character in the lumbar region and the whole of the left leg, unable to walk without severe pain. History of severe shock in France last year, followed by exposure to cold and wet in Servia recently. Patient was morose and distinctly suspicious. Tactile anæsthesia all over left side. April 6, 1916: Hyp., first stage. Suggestions of general improvement. April 7, 1916: No apparent result. Hyp., second stage. Same suggestions. April 8, 1916: Slight improvement. Hyp., third stage. April 9, 1916: Distinct improvement. Hyp., third stage. April 10, 1916: Less anæsthesia. Hyp. som. Suggestion loss of pain and anæsthesia. April 11, 1916: Pain almost gone, patient quite cheerful. Hyp. som. By April 16, 1916, patient was quite well, every symptom having completely disappeared.

Case 6.—No. 26017 Pte. M., aged 26. Hyperthyroidism. Selected by Colonel Garrod, C.M.G., A.M.S. April 8, 1916: Came under my care, suffering from palpitation, rapid pulse (100), cardiac pain, exophthalmos, blood-pressure 140-66, coarse tremor of hands. Hyp. som. Suggestions of nerve stability. This patient improved rapidly every day, but through a mistake was sent to England without my knowledge, on April 12, 1916, before he was quite well.

Case 7.—No. 16693 Pte. B., aged 21. Diagnosis, hyperthyroidism. Diagnosed by Colonel Garrod. April 14, 1916: Came under my care suffering from fainting fits, precordial pain, tachycardia, pulse 120, blood-pressure 136-80. Thyroid distinctly enlarged and causing some dyspnœa. This case got better in the ordinary way in fourteen days. Som. being reached at the first sitting and the ordinary suggestions being given.

Case 8.—No. 1249 Sapper S., aged 36. Diagnosis, trench shins. Selected by Colonel Garrod. April 14, 1916: Admitted suffering from extremely painful shins, so painful that patient would not allow anyone to touch his legs. April 15, 1916: Hyp. som. Suggested loss of pain and tenderness. April 16, 1916: Much less pain and tenderness. Hyp. som. Same suggestions. April 17, 1916: No tenderness left, only some aching on walking. Hyp. som. Suggested that aching gone, and that patient can walk without discomfort. April 18, 1916: Aching almost gone. Hyp. som. Patient made to walk about freely, stating at the time that he did so without pain. April 19, 1916: No symptoms left, but some weakness. Hyp. som. April 22, 1916: Patient quite well.

Case 9.—No. 136 Pte. L., aged 32. Diagnosis. Sent by Colonel Thorburn, C.B., A.M.S. Psychasthenia with paresis right arm. April 15, 1916: Admitted from Cottonera mental ward. Patient in a melancholic state; very morose and depressed and prone to tears; very suspicious of the medical profession. He has a depressed scar in the right parietal region which is very tender. Since the injury (a kick from horse four

years ago) he has had great and increasing weakness of all the right side of the body, especially the arm and leg; and on examination he has considerable weakness of the right leg, and cannot move the right arm at all; there is practically complete anæsthesia of the right side, the muscles of the right arm are considerably wasted, and the skin of the hand and fingers is thin and shiny. At Cottonera hyp. som. with suggestions of happiness and confidence in his coming cure. April 16, 1916: Transferred to Valletta yesterday and arrived quite cheerful, stating that "there is nothing now the matter but weakness." Hyp. som. Suggestions of loss of symptoms, and training muscles of arm and leg. April 17, 1916: Patient all right now except for the loss of power in the arm and leg. From this point I gave the patient daily training of the affected muscles under hyp. som. for seven days longer, when I stopped, as he was so far recovered that I felt sure that he could do the rest himself. Patient went to England on May 12, 1916, perfectly well.

Case 10.—No. 16836 Pte. R. N., aged 20. Diagnosis, hyperthyroidism. Diagnosed by Colonel Garrod. April 14, 1916: Admitted suffering from ordinary symptoms of the trouble—viz., nervousness, palpitation, tremor of arms, pulse 120, pains in legs and back. April 15, 1916: Hyp. som. Suggestions of general nervous stability with loss of symptoms. This case went through the ordinary course of rapid improvement, and was quite well by April 24.

Case 11.—No. —— Gnr. B., aged 25. Diagnosis, neurasthenia. April 20, 1916: Admitted suffering from extreme constipation, with pain in the back and in the iliac region sufficiently severe to prevent patient walking. Hyp. som. Suggested relief of pains to follow action of bowels in the morning. April 21, 1916: No action of bowels, but pains much relieved. Hyp. som. Suggestion of action of bowels at 8.30 a.m. exactly the next morning. This suggestion was obeyed, and from that day to when patient left hospital he had a regular action every morning; there was no pain or trouble of any sort.

Case 12.—No. 07741 Pte. M., aged 27. Diagnosis, psychasthenia. April 20, 1916: Admitted suffering from complete right drop-foot, with anæsthesia slight in the upper thigh and increasing progressively down to the ankle and foot where it was complete. There was a history of an accident to the right foot eight years ago, but the weakness did not come on till a month ago. The man's feet are of an unusual shape, and though the right foot does not come up as easily as does the left, still in my opinion some of the difficulty is probably congenital. Under hyp., third stage—further than which I have not been able to get him—the movement of the foot has slowly improved, and to-day, April 11, 1916, patient can walk easily without dragging the toe, but the getting of perfect movement is a matter of a fairly long education.

Case 13.—No. 28080 Pte. A., aged 24. Diagnosis, neurasthenia. Diagnosed by Colonel Garrod. April 20, 1916: Admitted suffering

from severe and continuous pain in the back and limbs, and intense headache; cannot get out of bed without assistance. Hyp. som. Suggested relief of headache and pain. April 21, 1916: Pain in head and limbs gone, only a "feeling of weakness in head left." I renewed the suggestions each day till on April 26, 1916, patient said he was "fresh as a lark," when I discontinued treatment.

Case 14.—No. 6669 Pte. R. L., aged 24. Diagnosis, painful amputation scars. Sent by Colonel Thorburn. In the case of this man I was never able to get beyond the third stage, but he improved so rapidly that by May 2, 1916, I could do anything with the two stumps of the amputated fingers, which previously he would not allow me to touch. He assures me now that the feeling is precisely the same as in the skin of the other fingers.

Case 15.—No. 5922 Cpl. Q., aged 30. Diagnosis, neurasthenia. Sent by Colonel P. Stewart. About mid-February, after being enfiladed in a trench in Serbia got a pain in the left side, but remained on duty. On March 15 he broke down altogether, was taken with a "shaking all over," could not stand, "lost the use of his body." April 21, 1916: Admitted here from Tigne, suffering from constant clonic spasm of sterno-mastoids on both sides and the muscles of the right leg; the spasm became very violent if any notice was taken of him. Hyp. som. Suggested relief from spasm and general increase of nervous stability. These suggestions were repeated each day with rapid improvement till on April 30, 1916, the spasm had quite disappeared, and on May 2, 1916, treatment was discontinued as patient was quite well in every way.

Case 16.—No. 131150 Pte. H., aged 30. Diagnosis, hyperthyroidism. Admitted suffering from hyperthyroidism complicated by well-marked religious mania, and fainting fits. Patient was very despondent. This patient took longer than the ordinary hyperthyroidism case because of the difficulty experienced in getting him under hypnotic influence; however, after eight days I succeeded in overcoming the difficulty, and in ten days after that patient was quite well.

Case 17.—No. —— Cpl. A., aged 26. Diagnosis, hyperthyroidism. Diagnosed by Colonel Garrod. April 24, 1916: Admitted suffering from hyperthyroidism with specially well-marked precordial pain, and a systolic thrill felt at the apex of the heart. Hyp. som. Suggestions of relief of symptoms and general increase of nervous stability. He responded to treatment generously at once, and after eight days' treatment was discontinued as it was no longer necessary.

Case 18.—No. 9318 Cpl. E., aged 25. Diagnosis, pain in right great toe. April 27, 1916: Admitted suffering from pain and inability to walk after the removal of a part of the distal phalanx of the right great toe subsequent to gangrene after frost-bite sustained in France in December, 1914. On examination there is a scar on the under side of the great toe which is acutely tender, patient cannot bear to have a boot on.

Though I had no difficulty in getting this man to hyp. som. and I was able to relieve the pain for some hours each day, it always returned when he walked with his boots on, until on April 9, 1916, I tried the suggestion that there were nerve endings in the scar which would take three days to kill. This suggestion proved entirely successful, as on the third day, April 12, 1916, all the pain had gone.

Case 19.—No. 18408 Pte. S., aged 31. Diagnosis, hyperthyroidism. Sent by Colonel Garrod. April 29, 1916: Admitted suffering from hyperthyroidism with considerable enlargement of thyroid and marked von Graefe's sign. Hyp. som. at first time of asking, and patient made an uninterrupted recovery in eleven days, at the end of which time the thyroid had gone in size to normal, all symptoms had disappeared and treatment was suspended.

Case 20.—No. 13316 Pte. W., aged 24. Diagnosis, hyperthyroidism. Sent by Colonel Garrod. Admitted suffering from hyperthyroidism, with marked dyspnœa on the slightest exertion. This case, like the last one, took eleven days to recover, his thyroid gland going down to a normal size in that time with the disappearance of all the symptoms.

In commenting on these cases I wish to point out first that they are twenty consecutive cases taken in the order in which they arrived in my special wards—and here I wish to express my sincere thanks to my commanding officer, Captain Sexton, for the kindly and liberal-minded way in which he has allowed me the use of the said wards—and are only selected in the sense that they are all cases in which the ordinary methods of treatment have proved ineffective. This fact taken with my large previous experience of cases treated in this way, justifies me, I think, in stating that the results are in no way exceptional, and just what may be expected in any extension of the work. Although a large proportion of this small list of cases are of a functional type, Cases 2, 9, 14, 18, and possibly Nos. 8 and 12, cannot, I think, be regarded as wholly functional, and this point I particularly wish to emphasize: the usefulness of suggestion-therapy is not confined to what are called functional cases, and further a large number of cases exists in which functional and organic trouble are co-existent, and in these cases the removal of the functional element considerably aids the elimination of the organic trouble.

Having got thus far I pass on to my culminating fact, and I am sure that it is a fact, and it is this: There are thousands of functional cases being sent home regularly from the hospitals here, and there will be thousands more, practically in the same condition in which they left the war area, with the pious hope that the change will produce the cure that rest and medicine together have failed to produce. Giving the hope the best possible chances of realization, there will be thousands of these men who will not only not get better with treatment with rest and medicine, but will get worse and sink into a state of chronic

invalidism, which will mean an enormous bill to be paid by the country for pensions. Now practically all these cases can not only be kept off the pension list, but can be made fit for further service by suggestion-therapy, and every case which can be relieved by rest and medicine can be cured by suggestion-therapy in a fraction of the time.

This is the reason why I am putting in this plea for a fuller recognition of suggestion-therapy, that it may be given a fair chance to prove its value in saving the usefulness (and often the reason) of many a poor soldier, and in saving the country from a very large and unnecessary expenditure in pensions.

MULTIPLE SEVERE INJURIES FROM A BOMB-EXPLOSION: OPERATION; RECOVERY.

By Captain NORMAN DAVIDSON.
Royal Army Medical Corps.

The following case deserves attention on account of the multiplicity of the wounds, their seriousness and the good recovery following operation.

Pte. J. W. P., aged 25, while practising bombing on December 17, 1916, threw a bomb which burst prematurely at about a distance of a little over a yard from his head. This occurred about 11.30 a.m. He was dressed by the medical officer of his battalion and was brought at 12.45 p.m. by ambulance to this military hospital where he was examined immediately on admission. He was quite conscious and complained much of abdominal pain; he said he was quite blind. Pulse 120, temperature 97·4° F. Respiration 20. He showed a considerable amount of blanching and was suffering from great shock. His wounds were as follows:—

(1) Wound of the scalp two inches long on the vertex down to the bone.

(2) Perforating wound entering the abdominal cavity at the junction of the ninth costal cartilage with its rib on the right side.

(3) Wound of left thigh entering the left groin one inch below Poupart's ligament in a line with the vessels and with its exit below the left knee, apparently smashing the head of the tibia and tearing the patellar ligament.

(4) Wound in the right groin one inch below Poupart's ligament.

(5) Small superficial wounds of right and left arms, abdominal wall, etc.

Operation.—The patient was brought to the theatre at 3 p.m. the same day and anæsthetized by ether. He had already had ¼ grain of

morphine hydrochloride and 500 units of antitetanic serum. With the assistance of Lieutenant J. F. Gill, R.A.M.C., the skin around the wound over the ninth costal cartilage was excised and it was seen that the cartilage had been half torn through and a fragment had perforated the peritoneum. This wound was then sewn up. The abdomen was immediately opened in the hypogastrium by splitting the right rectus sheath and pulling the rectus towards the middle line, the nerves to that muscle being preserved by pulling downwards. The abdomen was found to contain about a pint of blood and blood-stained serum. This was mopped out and an examination was made of the abdominal contents. The liver was found to be intact, as was the stomach. The duodenum was found to have a perforating wound at the middle of the second part, practically in the centre of its anterior surface; this was closed with a Lembert stitch of linen thread. The jejunum was next followed and there was found, about twelve inches down, a perforation at the free edge and another on the mesenteric edge with a small chunk of bomb case lying in the mesentery. The missile was removed and the three holes closed by Lembert sutures of linen thread. No further abdominal lesion was found though it was noticed that gauze which had been placed near the duodenal lesion had a little bile on it, but search failed to reveal any injury. As the patient was in a very exhausted condition the search was not prolonged; a rubber tube rolled up in gauze was inserted down to the duodenum and another at the lower angle of the wound down to the recto-vesical pouch and the abdominal wall closed in layers. Attention was then turned to the left groin, the skin wound excised and there was found to be considerable arterial oozing from the depth of the wound, so it was opened up freely, the sartorius muscle retracted inwards, and the track of the foreign body was followed. This caused more bleeding. Digital pressure was put on the femoral artery and by following the track of the hæmorrhage, one quickly came on the femoral artery and vein at the upper end of Hunter's canal. The artery was isolated and ligatured above and below with stout catgut. On removal of digital pressure there was only a little venous oozing but on lifting up the artery there was quite a rush of venous blood. Pressure was applied above and below, the artery lifted up again when it was seen that there was a small longitudinal tear in the vein. This was stitched up with a fine linen stitch for want of better material, as it was considered that ligation of both artery and vein would be sure to invite the risk of gangrene. The sides of the wound were then drawn together at each end and the centre packed with gauze soaked in eusol. The wound in the knee was excised and opened up freely, when it was seen that the joint had not been entered but that the patellar ligament with the tuberosity of the tibia had been torn away. Loose bone was scraped out and the wound packed with gauze and eusol. The wound in the right groin was excised, the track followed down about eight inches to the adductor muscles. A

counter opening was made, the track well scraped out and a rubber tube placed along it. The scalp wound through an oversight was not excised and the patient was returned to bed with the right leg enveloped in cotton wool and placed in an elevated position. On recovering from the anæsthetic he was placed in the Fowler position. The next day the patient was very ill indeed. Pulse 130. Respiration 30. Temperature 99° F. He was given morphia freely. He had 1½ grains morphia hypodermically in the twenty-four hours and salines *per rectum* which he retained, also a turpentine enema to relieve some distension. 19th: He was better and had had a good night. Dressings were soaked through so he was dressed. There was no discharge from the lower abdominal tube but a free discharge of bile from the upper one, free oozing from the left knee wound, and no signs of gangrene in the foot. 20th: To-day the foot showed dry gangrene of all the toes. Circulation was apparently good up to the knee. The abdominal tubes and gauze were removed and the tubes only replaced. General condition satisfactory. Had bowels open but abdomen seemed distended. Good night. Pulse 96. Less bile escaping, tube shortened. Line of demarcation now begun to form at the middle of the calf. 25th: Patient doing well, but there was pain in the left leg and œdema above the line of demarcation. January 1, 1917: Complained of a great deal of pain during the night. Amputation was decided on and morphia hydrochloride ¼ grain and atropine sulphate 1/200 given. The operation was performed with anterior and posterior flaps. The bone was sawn through two inches above the knee. At the same time an opportunity was taken to draw together the edges of the wound in the left groin which had become a large granulating area, and the head wound scraped of redundant granulations. January 2: Patient says that he feels better than he has done since he came into hospital. No bile escaped to-day. Tube removed. January 7: All wounds healing well. January 17: Patient was quite convalescent and went to a concert on a wheeled chair. Wounds healed.

–To sum up, the patient was injured at 11.30 a.m. and was operated on three and a half hours later. The interval between the accident and the operation was to the patient's advantage as he was in better condition at 3 p.m. than on admission. Morphia, salines and warmth were all that was used to combat the shock.

I have to thank Lieutenant Gill, R.A.M.C., for his able assistance and advice, and Sisters Geeve and Frewin, Q.A.I.M.N.S.R., for their care of the patient.

NOTES ON A CASE OF TRAUMATIC HERNIA OF THE DIAPHRAGM PROVING FATAL SEVEN MONTHS AFTER THE WOUND.

By Captain C. P. SYMONDS.
Royal Army Medical Corps.

Pte. D., of the S.A.I., aged 29, was admitted to the Connaught Hospital on the afternoon of August 31, with the following history:—

Having had no previous illness and led a vigorous and healthy life, he was wounded in February, 1916, whilst fighting against the Senussi. He was stooping forward when hit, so that the bullet, which entered over the left scapula, apparently came to rest in the subcutaneous tissues of the abdominal wall in the left hypochondrium.

He was taken to a dressing station where he vomited some blood, and subsequently to a base hospital, at which an operation was performed on his abdomen, and he believed the bullet was removed.

Both wounds were healed in ten days, he was kept in bed for five weeks, became restored to full health and was eventually discharged to duty.

About six weeks after the original wound he had his first attack of abdominal pain; it was very slight, and he did not take much notice of it. Subsequently he had many such attacks—three or four a month, latterly they had become more severe, but he had not felt ill enough to report sick. He had observed that the attacks were nearly always preceded by constipation; he then had a premonitory feeling of uneasiness in the abdomen, and if he could now get his bowels to open well could sometimes avert the attack. The pain came on after, or half-way through a meal, and would pass off in a few minutes, being relieved when he lay on his right side; while it lasted it was very severe, but in between the attacks he felt quite well, though he thought his wind was not as good as it had been.

He was admitted in what he described as a typical attack, but much more severe than any before experienced. His bowels had not been open for two days, and then half way through breakfast had come on the pain; he vomited the food just taken, but with no relief.

On examination he proved to be a well developed man of normal physique; over the centre of the spine of the left scapula was the scar of the entrance wound; in the middle of the left hypochondrium was a healed, two-inch linear incision.

He complained of a dull, continuous pain across the upper abdomen, to which were added occasional paroxysms of agony, during which he turned pale and cold, and broke out into a sweat, while his pulse was small, slow, and irregular; the position he adopted during these paroxysms was very striking, sitting bolt upright with his knees huddled up to his chin, the slightest attempt at straightening the back being intolerable.

On inspection and palpation the left hypochondrium appeared emptier, and the left thorax fuller, than on the other side.

The physical signs in the chest resembled those of a hydropneumothorax. The right border of the heart was 2½ inches to the right of the sternum; the apex beat was not palpable, but was best heard in the fourth left space close to the sternal margin.

At the apex of the left lung the percussion note was of a higher pitch than at the right, and the breathing was bronchial. But from the second space downwards the note was tympanitic all over the cardiac area and continuous with the stomach resonance.

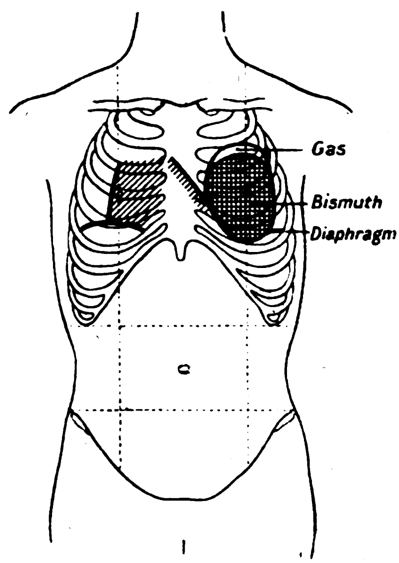


FIG. 1.—To illustrate X-ray appearance on August 31.

There were no breath sounds over this area, but with the patient in the sitting position curious tinkling sounds were audible in the third space. The signs at the back were similar, and bell sounds with coins were easily demonstrated.

The true diagnosis did not strike me at the moment; I thought the dilated stomach was pushing up the diaphragm. But in a quiet interval between two paroxysms I gave the patient three ounces of bismuth carbonate, and with the help of Captain Hawks, radiographer to the hospital, examined him with the screen. The horizontal position was the only available one, but the picture obtained was quite definite.

All the bismuth was contained in the stomach, which reached up to the second left rib in front, and above it could be seen the dense com-

pressed lung. The time for observation was limited, for the patient had a paroxysm of pain which compelled him to revert to the sitting position, but Captain Hawks was able to see a fine shadow to the left of the lower end of the stomach, having a slight vertical movement with respiration, which he took to be the diaphragm. The diagnosis of diaphragmatic hernia was now made. Most of the bismuth was removed by means of a stomach tube and evacuator, but this gave no relief. Two doses of ¼ grain of morphia were given in the night, and the patient had a little sleep still in the sitting posture, and as his general condition was better he was transferred early next morning to the care of the surgeons at the Cambridge Hospital.

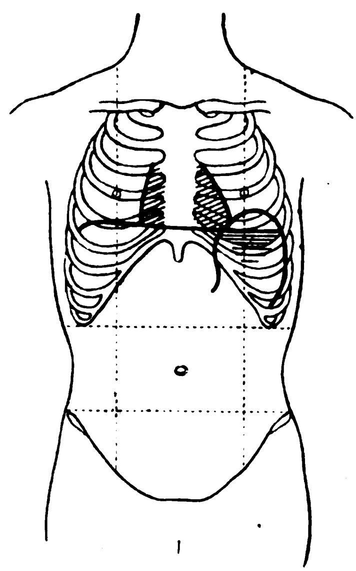


FIG. 2.—To illustrate X-ray appearance on September 19.

Here his condition rapidly improved, the pain disappeared, and in a few days he was able to take his food without discomfort.

Through the courtesy of the officer commanding the Cambridge Hospital and the officers in charge of the case, I was able to see the patient again nineteen days later. No operation had been performed, and he was apparently in normal health.

Physical examination showed the stomach resonance to reach the fourth rib, and the heart was a little displaced to the right. This was confirmed by X-ray examination in the vertical position.

The left dome of the diaphragm showed as a clear, thin line with no breach in its continuity; the stomach lay below it and the picture was

apparently that of distension of this viscus with consequent stretching of the diaphragm.

There can be no doubt, however, that the correct interpretation of this picture was that the surface area of the diaphragm was increased and its contractile power diminished by reason of the large gap in its substance which was subsequently discovered, and that the high position of the stomach with displacement of the heart was consequent upon this.

There was now some debate as to the validity of the original diagnosis. Those who opposed it brought forward the argument that the bullet, if it had indeed passed through the diaphragm, must have damaged the scapula, of which a plate was produced showing no evidence of injury; moreover, that continuing its course, it could hardly have failed to pierce the heart and so cause death.

Subsequent events showed the fallacy in any argument based on the theoretical course of a modern bullet between wounds of entrance and exit.

A fortnight later the unfortunate patient had another attack of abominal pain; operation was performed, and the hole in the diaphragm found, but his condition was desperate, and he subsequently died of shock.

At the post-mortem a large circular opening with quite smooth and rounded edges was found near the centre of the left dome of the diaphragm, which would admit of a medium-sized hand being passed into the thorax, in which were contained the stomach, great omentum, transverse colon, and the upper half of the small intestine, the last being kinked in several places, distended, and of a deep plum colour. The stomach reached as high as the second rib and was partly adherent to the chest wall; the apex of the heart lay just to the left of the sternum.

Finally, the expanded copper casing of a rifle bullet was discovered in one edge of the wound in the diaphragm, but no trace of the leaden core was found; presumably it was that which had been removed from the abdominal wall.

A remarkable point about this case is the length of the history. The wound in the diaphragm must have existed from the first, and apparently the increased intra-abdominal pressure resulting from constipation was the occasional cause needed to force a knuckle of stomach through the opening. The contractions in this knuckle set up by taking food then caused the agonizing pain, partly relieved only by the crouching position, in which the tension of the diaphragm was reduced to its minimum.

To this was added the continuous ache probably due to the drag of the stomach and other viscera upon their peritoneal attachments.

Up till the attack in which I first saw him spontaneous reduction must have occurred quite easily on every occasion, and eventually happened even after the stomach had been above the diaphragm for at least twenty-four hours.

Of the symptoms when the patient was first seen, the most important features were the presence of gastric distension and abdominal pain *without* vomiting, the fact that the condition was not relieved by the passage of a stomach tube, and especially the posture adopted.

Although in this case the rent in the diaphragm was so large that nothing could have been done to repair it, it is possible that such cases may occur again and that an earlier diagnosis might enable the surgeon to operate with some hope of permanent relief.

I am indebted to Lieutenant-Colonel W. Turner, Officer Commanding the Connaught Hospital, for permission to publish this case.

Report.

PROVISIONAL INSTRUCTIONS FOR THE TREATMENT OF CASES OF MALARIA IN THE UNITED KINGDOM.

(1) *The treatment of a large number of cases of malaria (mostly Benign Tertian) in special malaria wards in England during the last five months by a number of specially qualified medical officers has elicited the following facts :—*

(*a*) Comparatively small doses of quinine, namely, from twenty to thirty grains daily, sufficed to reduce the fever and the asexual parasites in two to four days in the large majority of cases.

(*b*) Cases which had become anæmic, owing to past attacks of malarial fever, generally recovered from their anæmia if this treatment was continued for two or three weeks, especially when arsenic and iron were given at the same time as tonics.

(*c*) No line of treatment yet tried, however (and more than twenty different lines have been tried), has sufficed to eradicate the infection entirely in more than a small percentage of cases, and no clear indication has yet been obtained that any one line of treatment is much better in this respect than another. Large doses, reaching sometimes 100 grains a day continued for several days; intravenous injections amounting to fifteen grains daily for ten days consecutively; thirty grains orally continued for sixty days; and various combinations of intravenous, of intramuscular, and of oral quinine, continued for various periods, have hitherto failed in a similar manner; and, in many cases, twenty or thirty grains continued while the patient has had fever, and for three days afterwards have sufficed to keep him free from relapses for as long after discontinuance of the treatment as the more massive dosing has succeeded in doing.

(*d*) No marked difference has been found in the actual results as regards reduction of fever and the parasites, and also as regards the prevention of relapses, between intravenous, intramuscular, and oral quinine, or between the various salts of quinine which have hitherto been tried, or between solutions, powder, or tablets. Perhaps large doses of the sulphate dissolved in considerable quantities of acid are less well borne by the stomach than similar doses of the hydrochloride; and large quantities of quinine are better borne if given partly intramuscularly and partly orally, or if distributed in small doses at different times during the day.

(*e*) In the opinion of many medical officers, men who have been more or less continuously treated in hospital are, if anything, more anæmic

and out of condition than men who have been doing full or light duty, with continued treatment out of hospital.

(*f*) Men who have received vigorous quinine treatment with a view to eradication of the infection, and who have afterwards been sent to duty without any quinine out of hospital, sometimes tend to become anæmic although they do not show marked fever while out of hospital.

(*g*) There is not much evidence as yet in favour of very large doses either for reducing fever or for preventing relapses. Perhaps the optimum dosage is from twenty to thirty grains daily for reducing fever, and sixty grains weekly for keeping off relapses. The best time in the day for giving the bulk of the daily dosage appears to be about four hours before the time when the attack usually occurs.

(*h*) Men who have been given an anti-relapse quinine-prophylaxis of only five grains daily have relapsed while taking it to the extent of thirty per cent of the cases. But men who have been given ten grains anti-relapse quinine-prophylaxis daily, or as little as twenty grains on each of two days only of every week, have shown a much smaller percentage of relapses while taking this dosage. Men have been given as much as thirty grains of quinine daily while they were doing full duty in camp, without having relapses or suffering much inconvenience from this medication. It does not seem to matter much whether quinine is given in large doses on two or three days a week, or in smaller doses every day, so long as the total amount given during the week is the same.

(2) *The following instructions are therefore issued in supercession of those dated April,* 1917, 24/*Gen. No.*/5500, *and will be followed as closely as possible both for officers and men.*

(i) Every case of malaria will be given sixty grains of quinine every week until he has been free from malarial fever for at least sixty days. This rule applies to all cases whether serving with their units, or in depots, or on furlough, or in hospital (under other diseases as well as malaria); and it is to be set aside only if there is special medical reason for doing so.

(ii) The sixty grains of quinine may be administered intramuscularly or orally, and in the form of sulphate, hydrochloride, or bihydrochloride, preferably the sulphate. It may be given at the rate of ten grains daily on six days in the week; or of fifteen grains daily on four days in the week; or of twenty grains daily on three days in the week; or of thirty grains daily on two days in the week, on consecutive days or not; in doses of five grains, ten grains, or more; and in solution, powder, or tablet, as convenient.

(iii) The administration is to be made under the direct supervision of a medical officer, who will be responsible that the dose is really taken.

(iv) In addition, every officer or soldier who is receiving such treatment out of hospital will have in his possession, during the two months immediately following his last attack of fever, a bottle containing twenty

tablets of sulphate of quinine of five grains each, and will be instructed to take enough of these tablets to make up the weekly amount of sixty grains when for any reason, such as the individual being on leave or otherwise absent, the doses cannot be administered under the supervision of the medical officer. The officer or man will also be instructed to take one or two tablets, in addition to the usual dose, at any time in the day when he feels out of sorts or thinks that a relapse of malarial fever is about to commence; he should, however, report the circumstances to the medical officer the following day, or earlier if the attack does not subside.

The date on which the treatment may cease (sixty days after the end of his last attack of malarial fever) must be entered on the bottle.

(v) The bottle of quinine will be given by the medical officer to the officer or man concerned, whose name, rank, corps, and regimental number will be written on the bottle. The medical officer will make iuquiry at medical inspections as to whether the patient has duly taken the tablets from the bottles when necessary; and, if the patient has suffered from a relapse in the meanwhile, will warn him regarding the danger of neglecting the said instructions. The officer or soldier must bring the bottle to the medical officer when it requires refilling.

(vi) Cases reporting sick for attacks of fever in spite of this quinine-prophylaxis are to be treated as follows:—

(*a*) If the fever is slight, the patient may be detained for one or two days, and be given thirty grains of quinine for each day on which he is detained, and another twenty grains on the day on which he returns to duty.

(*b*) If the fever is more severe, the patient should be admitted into hospital, and be given about the same doses of quinine (thirty grains), while the fever continues and for three days afterwards, and be then discharged to duty if otherwise fit.

(*c*) If the patient suffers from anæmia as well as fever, or from malarial anæmia only, he should be kept in hospital for longer periods, and be given sixty grains of quinine weekly, in such manner and with such additions as the medical officer may prescribe, until he is otherwise fit to return to duty.

(*d*) After discharge or transfer, the patient should continue the sixty grains of quinine weekly, as ordered above, until he has been free from fever for at least sixty days.

Lecture.

STORIES FROM THE CAMPAIGNS OF NAPOLEON AND WELLINGTON.[1]

By Colonel C. A. BALLANCE, C.B., M.V.O.
Army Medical Service (Consulting Surgeon).

(Continued from p. 245.)

Wound of Right Frontal Sinus.

"The bullet fractured the external wall of the sinus and split into two portions, one passed over the frontal bone, tearing up the skin for about a centimetre, the other lodged in the sinus and fractured the inner wall. The injury was followed by loss of consciousness and some slight symptoms of commotion.

"The external fracture was of small extent, and one could with difficulty believe that it had allowed the entry of half a bullet. The fragments were not displaced, and I was obliged to trephine over the sinus; by this means I discovered the foreign body and a fracture of the inner table. I extracted the lead easily with an elevator and applied a smaller trephine-crown to the inner table and perforated without difficulty the floor of the sinus. There was some blood extravasated between the bone and dura mater, which escaped. All symptoms subsided in a few days and the man made a good recovery."

Bullet Lodged in the Skull. Extra-dural Abscess.

"The bullet, after perforating the frontal bone near the sinus, passed obliquely backwards between the bone and dura mater, following the direction of the superior longitudinal sinus as far as the parieto-occipital suture, where it lodged. All the symptoms of compression were produced without any indication of the locality of the foreign body; the patient, however, always referred the pain to a point diametrically opposite the wound of entry, and the other signs left no doubt of the presence of a ball inside the skull. I introduced a gum elastic catheter into the hole in the frontal bone and easily made it follow the track of the ball, which I recognized by its resistance and irregular surface. I measured on the outside of the skull the length of the track and made a counter opening with a large trephine, a quantity of pus escaped, and I easily extracted the ball, which had depressed the dura and compressed the brain. There was no further obstacle to recovery."

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[1] A Lecture delivered in the Council Chamber of the Valletta Palace on May 12, 1916, to the Medical Officers of the Malta Command.

Epiglottis Carried Away by Bullet.

"The bullet entered at the angle of the jaw, passed obliquely through the throat and emerged in the jugular region of the opposite side. The base of the tongue was grooved and the epiglottis carried away; the man spat it up after the injury, and showed it to the surgeon, who rendered first-aid. He did not suffer much pain, but his voice was scarcely audible. Whenever he tried to swallow, he suffered from coughing and vomiting. Tormented by thirst, he made repeated attempts to swallow, always with the same result. He had passed four days in this miserable condition when I saw him; luckily I had an œsophagus tube with me, through which I fed him. The man recovered. Speech and deglutition became in time perfect; doubtless the functions of the epiglottis were performed by the hypertrophied arytenoid cartilages and the extremity of the base of the tongue."

Snow-blindness. English Prisoners After or During the Retreat to Corunna.

"An English drummer-boy, 12 or 13 years old, and his father, a corporal in the same regiment, were prisoners. The child, whom his father kept constantly on his knee, was completely blind. The blindness, according to the father's account, came on suddenly while passing over the Asturias Mountains during the severe cold of the winter he had just passed through; this cold must have had all the more effect on him from his hair having been cropped, and that, like nearly all the English prisoners, he had had to march barefoot all the way from Corunna to Valladolid. The grief of the father at the pitiable condition of his son was indescribable. Many of his comrades sincerely shared his grief, and I noticed with great satisfaction that all these prisoners were much attached to each other, and showed a tender aud generous mutual affection."

The treatment was the application of a moxa at the angle of the jaw, followed by the cautery. Recovery of sight ensued.

"I procured a little Spanish cloak for this young prisoner that he might be more warmly clad; in the end I had the satisfaction of seeing father and son start for France quite cured."

(It is to be hoped that they reached England; our present foes would neither act nor speak so well.)

Anomia: Loss of Memory of Names.

An officer who had served through the Russian campaign had several times been wounded. He was again wounded with a fencing foil. The weapon entered in the left canine region near the ala nasi, and penetrated obliquely from below upwards and a little inwards. It doubtless passed through the cribriform plate, and seemed to have reached the anterior

end of the corpus callosum. On examination, he was found to be suffering from right hemiplegia, amaurosis, loss of smell and taste. In a few days sight returned in the right eye, and after a month in the left. Diplopia was, however, present. Smell was recovered in right nostril and taste on right side of tongue.

"Memory of nouns in any way related to proper names was totally abolished, and was only imperfectly regained, while memory of images and of anything that could be described was intact. He had forgotten the names of all his relations and friends. His expression was: 'I have him before my eyes, but I cannot remember his name.' He could not name any of the parts of a gun, but could describe them all perfectly."

Larrey was obliged to leave a case of head injury, in which he was particularly interested, so he left instructions that when the man died, the head was to be cut off and put in a barrel with preservative, and sent on to France to him, which was done.

Effusion into the Pleura.

Larrey does not seem to have had much experience in excising ribs. He relates one case in which he tried to cut out a piece of rib so as to give more room. He seems somehow to have been very unsuccessful with the "operation for empyema." How strange it is that one who could do eleven amputations at the shoulder joint in a morning (besides other work) should hesitate to cut out a bit of rib.

The Great English Surgeon, G. J. Guthrie, F.R.S.

Guthrie was an historian of many military incidents which occurred in the battles of the Peninsular War. He is also the historian of the surgery practised during the Campaign in the Peninsula. Guthrie relates, too, many cases he observed after the battles of Quatre Bras and Waterloo.

He wrote on amputations, diseases of the eye, gunshot wounds of the chest, head, abdomen, pelvis, and limbs; and on many other surgical subjects.

In the preface to his book on gunshot wounds of the chest, published in 1848, he makes some trenchant remarks on the medical administration of the Army. (What a contrast with the British Army Medical administration in 1915 and 1916.)

"When the army under the command of Sir Arthur Wellesley landed at Mondego Bay (Portugal) in August, 1808, only two carts drawn by bullocks were loaded with stores for the Medical Department, and it was only when the army had attained the summit of the Pyrenees more than five years later, at the beginning of 1814, that the Medical Department could be said to be efficient. The last victory, that of Toulouse, was won on April 10, 1814."

"The hospitals of Toulouse were left in the highest order. The French and English surgeons visited each other. Every case of interest was thoroughly investigated, and the surgery of the British Army and of the French Empire dates much of its improvement from the facts elicited or confirmed on that occasion."

"Within one year the battle of Waterloo took place. The army was not the Peninsular army, neither were all its doctors. Few, if any, of the medical staff officers had seen a field of battle. I found the assistant surgeons doing everything they should not have done. The greatest efforts were made to obviate this state of things. Amateur surgeons flocked over from London. They rectified these evils as far as they could, but nothing could recall the past or the irretrievable mischief the insufficient medical care had occasioned in the first few days."

"The same result has followed the four great battles lately fought in India (written in 1848), the same loss of life, the same succession of human sufferings, and the same loss to science. The surgeons were overwhelmed by the extent of their labours."

"It does not signify by whom an army is commanded—the same evils will always follow if the same system is pursued. It may be the Duke of Marlborough or the Duke of Wellington, a Moore or a Lynedoch, a Beresford or a Hardinge. Their armies have suffered alike on this point, and their successors will also suffer if the civil authorities of the country will not allow themselves to be *guided in matters medical*, which they do not practically understand, and a knowledge of which they have not acquired in a manner to render it thoroughly efficient."

"At the battle of Inkermann, a young officer, the son of a friend of mine, was wounded in the leg by a musket ball, which caused much loss of blood. A tourniquet was applied instead of the required operation being performed, and he was sent on board a transport at Balaklava. The leg mortified as a matter of course, and was amputated. He died an eternal disgrace to British surgery, or, rather, to the Nation which will not pay sufficiently able men—and therefore employs ignorant ones—the best they can get for the money."

Guthrie had, perhaps, more of a scientific bent of mind than Larrey. He writes: "Surgery is never stationary, and surgeons of the present day must continue to show that surgery is as much a science as an art."

"I believe nothing in surgery until fairly tried and found to answer." Again, "A knowledge of the practice of physic is inseparable from the practice of surgery if the patient is to receive that assistance which the art and science of medicine in its most comprehensive sense can grant. The distinction between surgery and physic is artificial, one unknown to Nature, foreign to her principles, and incapable of being preserved by those who have extensive opportunities of practising the profession."

Guthrie lectured to medical officers of the army stationed, or on leave, in London for twenty-two years, from 1816 onward, without fee or any

recognition by the War Office. He remarks: "It is thought proper to employ a gentleman of high character to teach the veterinary surgeons how to cure the horses of the army; and surely something of the same kind should be done for the men."

Guthrie was a great believer in the therapeutic value of bleeding and in giving a light diet to wounded men. As to bleeding, who can doubt that it is still a valuable therapeutic agent, and many of Guthrie's cures strongly support this view. As to the question of feeding the wounded, a letter to Guthrie from Lieutenant-Colonel Dumaresq, dated July 2, 1815, throws light on this question from the point of view of the wounded men. Dumaresq was shot in the chest at Hougomont on June 18. The last part of his letter is as follows: "N.B. Up to this period, July 2, the devil a bit have I eaten.

> "Whilst with mutton chops and nice loins of veal
> You stuff your damned guts, your hearts are all steel,
> Oh ye doctors and 'pothecaries, you'll all go to hell
> For cheating our poor tripes of their daily meal."

Guthrie was an opponent of the practice of flogging in the army and describes how useless this punishment was. He relates the case of a soldier named Needham who from first to last received 15,000 lashes without their being the slightest use to him in the way of reformation. This soldier, he says, was a grenadier of the finest order of men, a fellow of the kindest heart, an excellent soldier, but he could not resist rum. In America in summer or winter, for heat and cold were nothing to him, he would swim the harbour of Halifax on a stormy night and return to his post with as many bladders of rum tied round his neck as he could get money to buy. Of course, everybody got drunk and Needham was flogged. He never disputed the justice of the sentence and admitted that he could not refrain from doing the same thing again. A brand is not affixed to a felon and Guthrie writes that it should not be to a soldier. Poor Needham died in the element he had so often braved with impunity. He was carried off the forecastle of a transport by a heavy sea in the Bay of Biscay and was long seen buffeting the waves in vain. No rescue was possible. Guthrie concludes this story with the words "Needham was the beau ideal of a Grenadier."

How differently the soldier was cared for in the Peninsula to what he is now is seen in the following paragraph :—

"War is an agreeable occupation, trade or professional employment for the few only, not for the many; and particularly not for the poor when they have the misfortune to have their limbs broken by musket-shot. There are very few men in England who know what are the principles of a medico-military movement with an army in the field, and it will not materially signify whether there should be even one so instructed until the nation at large shall be impressed with the idea that no expense, no trouble, ought to be spared to obtain for their soldiers so

unhappily injured the utmost comfort and accommodation that can be procured for them, as well as the best surgical assistance. The first was little attended to in England during three-fourths of the Peninsular War, and the latter was supposed to be obtained, when the demand was urgent, by giving a warrant to kill or cure to persons as dressers who were unable to undergo an examination with any prospect of success, and prove themselves worthy of a commission. Many a gallant fellow lost his life from the want of that proper care and attendance alluded to: many a desolate and unhappy mother mourned the loss of a son she need not have mourned for under happier circumstances, and who might have been the support and happiness of her declining years.

"Yet England calls herself the most humane, as well as the greatest nation upon earth; she claims to be the most civilized, and she may be so; but certainly in the care of those who have hitherto fallen in her defence, she could not on many occasions have been more careless or less compassionate."

Gunshot Injuries of the Head.

What Guthrie published in 1841 in the opening paragraph of his well-known lectures on injuries of the head is true to-day not only of injuries of the brain but of abscess and tumour of the brain also. He writes:—

"It may even be said that there is no one symptom which is presumed to demonstrate a particular lesion of the brain, which has not been shown to have taken place in another of a different kind. Examination after death has often proved the existence of a most serious injury which had not been suspected; and death has not infrequently ensued immediately, or shortly after the most marked and alarming symptoms without any adequate cause for the event being discovered on dissection. Such are the deficiences in our knowledge of the complicated functions of the brain, that although we can occasionally point out where the derangement of structure will be found which has given rise to a particular symptom during life, the very next case may possibly show an apparently sound structure with the same derangement of function."

Despite the great advances made since Guthrie's time it is clear that Guthrie's honest words are still sometimes true. The most eminent neurologists may differ as to the localization of a brain injury or disease. In the fable, men differed as to the colour of the chamelion and all proved to be right, but in the localization of a brain tumour or injury, if observers differ only one can be right and all may be wrong, for there may be no brain injury or tumour revealed either at operation or autopsy.

Guthrie's lectures on injuries of the head are full of interesting details. Here are some of his conclusions:—

(1) A fracture of the vertex is far less serious than a fracture of the base.

(2) Injury to the front of the brain is more dangerous than injury t the side of the brain, and much less so than injury to the posterior part

of the brain. (This probably refers to the compound fracture which follows fracture implicating the frontal sinus.)

(3) In some cases part of the brain injured can be distinguished by symptoms produced.

(4) In death from concussion Littré first demonstrated that there may be no visible injury, and this I have myself seen.

(5) Contrecoup injuries are rare, but they occur.

Ambroise Paré (Œuvres de Lyon), 1641, says:—

"Henry the Second, King of France, received a severe blow on his body at the tournament of the Field of the Cloth of Gold from a lance which broke but did not unhorse him. A splinter was driven by the shock under the vizor, which it raised, and struck him over the right eyebrow, penetrating the eye itself but without fracturing any of the bones of the orbit. He died on the eleventh day after the accident. On examination, a quantity of blood was found extravasated between the dura and pia mater under the occipital bone directly opposite to the part struck by the splinter of the lance, and the brain underneath to the extent of an inch was of a yellow colour and in a commencing state of putrefaction." Contemporary writers affirm that the King did not fall from, but was lifted off his horse, and did not, therefore, receive any other injury than from the single stroke of the lance. [This reference to the Field of the Cloth of Gold must be a mistake of Ambroise Paré or a mistake of translation (which hardly seems possible) of Guthrie, unless there was another Field of the Cloth of Gold besides the one English children are taught about. The tournament at which Henry II, King of France, received his death wound was held in the Rue St. Antoine in Paris. The King was tilting with the Captain of the Scotch Body-guard. The Captain's lance broke. By the rules the Captain should have at once thrown away the part of the lance that remained in his hands, but he did not do this. The broken end of the portion of the lance held by the Captain raised the King's vizor and then struck the King's eyebrow.]

Dodging Cannon Balls on Horseback.

"During the second attack on the hill which constituted the left of the British position at the battle of Talavera by the French, I found myself under the fire of a battery of twelve guns and just at the distance at which the shot began to ricochet or bounce like cricket balls. The position was not desirable and I tried to change it as quickly as possible by carefully guiding my horse between the shot. Whilst doing this, a soldier of the 48th Regiment, whose corps was immediately in front, came running up to me and begged that I would look at his head, for one of the balls, he declared, pointing to one that was passing by, had just alighted on it; saying this, he raised his cap and showed me portions of brain mixed with hair, the left parietal being very much shattered. I told him to walk to the field hospital."

Two Cases of Depressed Fracture.

C. Murray, Private, 1st Foot Guards, aged 33, wounded at Waterloo on June 18 by a piece of shell. The left parietal was broken and there was paralysis of the right arm and leg. Operation on June 20. Many depressed bone fragments removed. Complete recovery.

Mr. Mitchell of the Royals, aged 40, wounded by a musket ball at Waterloo. The vertex was injured, both parietal bones were fractured and depressed on either side of the sagittal suture. Symptoms: great pain, sickness, paralysis of both legs. June 28, operation on both sides of the sagittal suture. Recovery.

Many cases of injury to the middle meningeal artery were observed by Guthrie. "A French Artillery driver at the battle of Vimiera was struck on the side of the head by a musket ball near the anterior inferior angle of the right parietal bone. The case being reported to me I found him early the next morning unconscious in a village. I let out clotted blood from under the bone. The middle meningeal artery was torn across. This patient died, but many similar cases recovered."

"The inner table of the skull is often driven into the brain and operation should be done on the first day so as to avoid cerebral hernia and irritation. In fact all cases with depressed fracture of the skull *should be operated on at once.*"

Guthrie recognized the difference between depression of the skull in the child and in the adult. In the former he says, the skull is not brittle. He adds:—

"Heliodorus, who followed Celsus but preceded Galen, had much more proper ideas than many of his successors of a much later age. Heliodorus recommended a simple incision for exposure of the skull or two incisions in the form of a cross." (By far the best plan in cases of infected gunshot fracture of the skull.)

Another Case.

W. A., a private, wounded two days before Waterloo by a musket ball. The left parietal bone was fractured. The soldier was unconscious at first but on recovering consciousness could not speak. June 19, bullet and broken fragments of parietal bone removed. Sent to Brussels. Patient recovered.

Guthrie compares this case with one treated by Larrey. The inner table was driven into the anterior lobe and there was much suppuration. "I regret," says Larrey, "I did not operate at once, *Occasio princips judicium difficile.*"

Another Case.

Thomas O'Brien, wounded at Quatre Bras, June 16, by a ball fracturing the skull in the occipital region. There was much comminution of bone. June 28, large crucial incision, abscess and bullet in occipital lobe. Operation, says Guthrie, was too late to save life.

Guthrie relates how a severe blow on the skull may cause pulping of the brain beneath without fracture of the skull: and, he adds, if the dura does not pulsate it must be incised.

Guthrie relates a case which, I think, he saw with Larrey at Cairo. As both Larrey and Guthrie describe this case they probably assisted each other at the operation. Larrey's description has already been given. "A soldier was wounded by a musket ball in the middle of the forehead. It passed presumably between the bone and dura as far as the occipital suture. Symptoms of compression came on. A gum elastic bougie was passed along the track to determine where to apply the trephine. A large trephine was applied. The bullet and abscess were evacuated and the soldier recovered."

Guthrie says of hernia cerebri that after a time it is withdrawn within the skull, that it is due to a low form of inflammation of the brain and that its removal is erroneous, but he says Lambert of Marseilles relates a case of fungus cerebri, portions of which he cut off daily, but the treatment was interrupted as the patient in a fit of drunkenness tore off the remainder.

Guthrie was quite right about the pathology of hernia cerebri and the danger of cutting away such a granuloma. It has been done in all good faith in this War, but the surgeon had not read Guthrie.

Guthrie writes: "One of the improvements in modern surgery is to be found in the restriction which has gradually been placed on the repeated use of the trephine on the same person, and on the removal by this means of large portions of the skull. Saviard in 1702 trephined one person twenty times. Two surgeons of the King of Navarre removed both parietal bones from a patient by repeated trephining. He lived for thirty years afterwards. Solingen says that Phillip of Navarre, having been thrown from his horse, fractured his skull in several places by striking his head against the stump of a tree and that his surgeon trephined him twenty-seven times. Philip gave a certificate of this, and Solingen adds 'As a proof of his complete recovery he afterwards drank three of his companions to death.'"

Large portions of the skull are nowadays sometimes removed in order to extirpate tumours or for the purposes of decompression, but the operation is completed at one time; the many sittings referred to by Guthrie are a thing of the past.

The Treatment of Wounded Arteries.

Guthrie laid down the great principles to be adopted in wounded arteries. He writes: "The great principles of surgery to be observed in cases of wounded arteries, and which ought never to be absent from the mind of the surgeon, are three in number:—

(1) In primary hæmorrhage no operation ought to be performed if the bleeding has ceased.

(2) In secondary hæmorrhage the operation must be done even if the bleeding has ceased, because it will surely recur.

(3) That no operation is to be done for a wounded artery *but at the spot injured* unless such operation not only appears to be, but is, impracticable.

Illustrative Case.

Serjeant Wm. Lillie of the 62nd Regiment, aged 32 years was wounded in the right thigh on April 10, 1814, at the battle of Toulouse by a musket ball which passed through in an oblique direction downwards and inwards close to the bone, describing a track of seven inches. The ball was extracted behind on the field. He said he had bled a good deal on the receipt of the injury, which he had stopped by binding a band round the limb. The discharge from the wound was considerable; it appeared, however, to be going on well until the 20th of the month, when, on making a sudden turn in bed, dark coloured blood flowed from both orifices of the wound in considerable quantity. Guthrie says: "I had given an order, as the Deputy Inspector-General in charge of all the wounded, that no operation should be performed on a wounded artery without a report being sent to me, and an hour at least being granted for a reply, unless the case was of too urgent a nature to admit of it. It appeared to be so in this instance, and before I arrived Mr. Deare had performed the operation for aneurysm at the lower part of the upper third of the thigh. I could only express my regret that it had been done and point out the probability of the occurrence of the hæmorrhage from the lower end of the artery. This took place on May 7 when the limb was amputated, and the man subsequently died.

Guthrie adds: "French surgeons have related several cases of the successful treatment of cases of hæmorrhage from the main arteries which have occurred in gunshot fractures in the present war by exposure and ligature of the injured spot in the artery."

Gunshot Wounds of the Chest.

Guthrie on wounds and injuries of the chest is replete with interest. He advocated free opening of the chest in cases of hæmothorax. I think in Malta we have lost cases by not acting on this principle more frequently. Many of his chest cases recovered. In one case he removed pieces of cloth and spicules of bone from the lung, operating successfully through adhesions. In another successful case a 2lb. shot passed through the chest so that light could be seen from front to back.

Wounds with bayonets and lances are very uncommon, says Guthrie. "Regiments advancing with the bayonet seldom meet their foes: discretion becomes the better part of valour: one party walks silently and angrily away."

"A piquet of Portuguese infantry being surprised by a sudden rush

of French cavalry from the town during the first unsuccessful siege of Badajos were nearly all sabred. Those who survived were brought to me. Two, who had been run through one side of the chest, were losing blood from their mouths and wounds. The wounds were closed by stitches and compresses and brandy and water given. Both cases did well."

Musket Balls do not always Penetrate.

"A soldier at Talavera crept up to me white as a sheet. On opening his coat I found a musket ball had struck the sternum. This ball had made a rounded indentation in the skin. A few days later in the retreat from Truxille I saw him. He gave me a piece of hog in gratitude, which I accepted as I was very hungry.

"Lieutenant Tylden Patterson was struck, in the Pyrenees, by a ball in the left breast. I found the ball had been stopped by a copy of 'Gil Blas' which was in the lieutenant's pocket. When struck he sprang three feet in the air and fell breathless and apparently dying. Many days elapsed before he recovered. It should be noted that a severe non-penetrating blow may lead to inflammation of the pleura and lung."

I saw a somewhat similar case with the late Sir Prescott Hewitt after the battle of Tel-el-Kebir. A colonel of the Artillery rode up to an Egyptian and told him to throw his musket away. Instead of doing so he fired point blank at the officer. The bullet smashed the left elbow and a large watch which was in a pocket over the heart and then stopped without perforating, but only bruising the skin. The bridle arm dropped and the colonel fell from his horse as if dead. Recovery from the blow over the heart occurred in a few hours.

"General Sir Lowry Cole was struck by a musket ball at Salamanca on July 22, 1812. The ball entered below the left clavicle breaking the first rib and came out through the scapula. He spat blood for three days. The pulse in the left arm was much smaller than in the right and fears were felt that hæmorrhage from the subclavian artery would occur. Several fragments of the scapula and a large piece of the first rib came away, but three months after the injury he resumed command of the 4th Division. The arteries of the left arm always beat less forcibly than those on the right. He died from rupture of an abdominal aneurysm in 1844." (A similar case was nursed in Malta last summer.)

"General Sir Andrew Barnard was wounded at the passage of the Nivelle on November 10, 1813, by a musket ball which penetrated between the right second and third ribs. He suffered much loss of blood from the mouth, great difficulty in breathing. Pieces of bone and cloth came away from the wound, and in eight weeks the General resumed his command."

"Lieutenant-Colonel Harcourt and Major Jellies of the 40th Regiment were both shot through the chest at the assault of Badajos. They were

taken to the same tent. Inflammatory symptoms ran high in both. "In Major Jellies, a tough old Scotchman, they could not be subdued, but Colonel Harcourt slowly recovered."

Resection of Rib.

"The operation for empyema," writes Guthrie, "is of right ancient and military origin. Phalereus, Jason and Prometheus being expected to die of abscess in the lungs, declared to be incurable, went into battle for the purpose of getting killed, but each being fortunately only run through the body, they all recovered in consequence of the escape of the purulent matter through the holes thus made."

Hippocrates certainly operated for empyema, but Ambroise Paré seems to have been the first to use the trocar and cannula. Guthrie writes much on this subject and strongly urges that, as soon as much fluid accumulates in the chest a free opening should be made low down in the wall of the chest so as to completely evacuate it.

A non-commissioned officer of the cavalry, was wounded at the battle of Albuera on July 16, 1811, in the left chest by a lance. He became insensible from loss of blood from the wound and from the mouth. Some days afterwards he was brought to Guthrie with great difficulty in breathing, so that he was obliged to be raised nearly to an upright position. The wound had closed; the chest was full of blood. Guthrie operated and removed a large quantity of bloody purulent matter. In three weeks time the patient was convalescent.

Guthrie also relates cases of bullets lodged in the mediastinum, and gunshot injuries of the heart and pericardium.

Gunshot Wounds of the Abdomen.

In Guthrie's lectures on gunshot injuries and wounds of the abdomen, the details of 112 cases are given. He describes very fully the history of the operation of suture of the intestine, but omits to mention that Celsus, fifty years B.C., sutured perforations of the intestines, cut away gangrenous omentum and sutured the abdominal wall in layers. Guthrie says that "the idea of sewing together and thereby restoring the continuity of the bowel is attributed to four surgeons of Paris, who having united their efforts for the relief of the sick poor in that city in the thirteenth century, procured a portion of the trachea of an animal, one end of which they introduced into the upper end of the divided bowel and the remaining piece into the lower end. They then brought the divided ends into contact and retained them by as many stitches as appeared to be necessary."

Guthrie describes cases of musket balls traversing the abdomen. In some of these blood was vomited and passed *per rectum* and yet they recovered, and many of us have seen such cases. In cases of prolapse of omentum and intestine Guthrie cut off the omentum and when necessary

sutured the intestine. He could not operate on abdominal wounds so successfully as my colleague, Cuthbert Wallace, has done in France, as he died before the era of anæsthesia and antisepsis. In abdominal injuries he says the chief cause of death is hæmorrhage. Pelvic injuries he looked on as very serious. Cases of gunshot wounds of the liver he had known to recover. General Sir John Elley was wounded at Waterloo in the last charge of the heavy cavalry, by the point of a sabre, below the ensiform cartilage. The stomach was wounded but the patient did well.

Guthrie relates the case of an insane lady, who opened her abdomen with a pair of scissors and then cut away seventeen inches of small intestine. She recovered. "Injuries of the spleen are usually fatal from hæmorrhage, but a prolapsed spleen, he says, may be cut off and the patient may recover."

Cases are related, too, of hæmorrhage from solid viscera and rupture of hollow viscera from non-penetrating blows, and Guthrie contrasts these cases with a rupture of small intestine by a kick of a horse over the pubes with no bruising of the abdominal wall. Guthrie relates with approval, a case of Baron Larrey's in which the abdomen of a soldier was grazed by a musket shot. Larrey opened the abdomen and removed much blood. The patient was much better for the operation, but died a few days later.

At the evacuation of Gallipoli, I operated on two cases of gunshot wound of the abdomen shortly after the wounds had been received. In the first case the liver had been injured and there was much hæmorrhage, but the soldier did well for three days, when he died suddenly: of secondary hæmorrhage, I suspect. In the second case, the blood came from a very severely torn mesentery of the small intestine. There was great intramesenteric extravasation and the case was hopeless.

Guthrie relates the case of a private of the 43rd Regiment who was accidently injured by a ramrod entering below the navel and penetrating the second lumbar vertebra. Much force was required to extract it. The man recovered.

Guthrie was very much interested in a case of gunshot wound of the abdomen of a private at the battle of Sobraon, February 10, 1846. The man came to England, and died under Guthrie's care. At the post-mortem an opening was found in the diaphragm and the stomach, transverse colon and omentum had herniated into the left chest.

Gunshot Wounds of Knee-joint.

Guthrie writes: "Wounds of the knee-joint from musket balls with fracture of the bones composing it require immediate amputation. Many cases of wound in the knee-joint in which the capsular ligament has been wounded and the articulation opened into without injury to the bones, do well, such as simple incised wounds made with a clean-cutting instrument. The success attending all wounds of the knee-joint depends

entirely upon absolute rest, upon the antiphlogistic mode of treatment being rapidly enforced, on the healthy state of the atmosphere and on the locality being free from endemic disease . . . but wounds of the knee-joint, however simple, should always be considered as of a very dangerous nature, infinitely more so than those of the shoulder, the elbow, or the ankle."

"*When a poultice to a gunshot wound of this kind is applied I consider it the precursor of amputation.*"

Gunshot Wounds of Joints other than the Knee.

The following operations are recommended mainly with the view of getting good drainage and in order to avoid amputation:—

Gunshot wound of elbow—*excision of joint.*

Gunshot wound of upper arm with injury to upper part of humerus—*removal of head of humerus.*

Gunshot wound of upper part of femur with involvement of the hip-joint—*removal of head of femur.*

In his lectures in London he said about removing the head of the femur in gunshot fractures involving the hip-joint: "I have not done this operation on the living man *but you must do it*, and I am sure you will succeed in saving life in the end."

Amputations.

Guthrie writes: "The removal of a limb should not occupy two minutes, but the securing of the blood-vessels should be done without reference to time; when carefully effected there is little fear of secondary bleeding, and the stump should be closed at once."

Guthrie was strongly against the practice of amputation for almost any injury to a limb. He says: "A wound of the femoral accompanied by fracture of the femur, however, requires amputation." We have saved some such cases in Malta but have also lost them by too conservative treatment.

In very foul and sloughing wounds Guthrie recommended the application of sulphuric acid 1 in 12. This reminds me of the use of Ricord's paste when I was a dresser—it was used for rapidly extending venereal gangrenous ulceration.

Compound Fracture of Humerus.

"Receive it as a general rule that whatever may require to be done in the first few days had better be done on the first than on the second. A free vent for matter is always of the greatest importance. If the bone is greatly shattered an incision sufficiently large and deep to enable the surgeon to remove the splinters will be necessary. Add to this a wound of the brachial artery on which you must place two ligatures, one above the wound and the other below it. You will now perhaps be able to put your fingers through the arm and the wound will look ugly. *Nevertheless*

the arm must not come off. It is only sixty seconds or so between an arm off and an arm on, but as a man is not a crab he must run great risks to keep his arm."

CONCLUSIONS.

"(1) An upper extremity should not be amputated for almost any accident which can happen to it by musket ball, and there is scarcely any injury of the soft parts which would authorize amputation as a primary operation.

"(2) If the head of the humerus is shattered it should be removed. The patient will have a good arm. I disagree with Baron Larrey and the French surgeons who say that injuries of the upper third of the arm bone require amputation.

"(3) If the elbow joint is shot through excise it if you know your anatomy.

"(4) A forearm should not be amputated except for special reasons and a report must be sent to the Inspector General. Arteries should always be secured at the site of bleeding.

"(5) Serious injury to the wrist joint generally requires amputation."

Time at which Amputation should be done.

"Although military surgeons have agreed in general as to the necessity of the operation in particular cases yet they have disagreed very much, and still disagree, as to the precise time when it should be performed, some recommending it to be done as soon as possible after the receipt of injury, others, again, deferring it until a period of from three to six weeks, when the first inflammatory symptoms shall have abated."

Wiseman, surgeon to Charles II, who served in the Army during the war of the rebellion and also in the Navy against the French, says in the fifth edition of his work published in 1719, "In the heat of fight, whether on land or sea, the surgeon ought to consider at the first dressing what probability there is of preserving the wounded member and accordingly, if there are no hopes of saving it, to make his amputation at that instant, whilst the patient is free from fever. Amongst us abroad it was counted a great shame to the Chirurgeon if that operation was left to be done the next day, when the symptoms were upon the patient and he spent with watchings."

Le Dran, consulting surgeon to the French Army, wrote in 1740, "That when an amputation was indispensably necessary in the case of gunshot wound, it ought to be done without delay."

Ranby, surgeon to King George II in his campaigns in Flanders, confirmed the opinion and practice of Wiseman (1760). "The neglecting of this critical juncture of taking off a limb frequently reduces the patient to so low a state and subjects his blood and juices to such an alteration as must unavoidably render the subsequent operation, if not entirely unsuccessful, at least exceedingly dubious."

Bilguer, who was in 1762 Surgeon-General to the Prussian Army, published a treatise against amputation in general. In consequence of this opinion he suffered no amputations to be performed in the Prussian Army. "Bilguer," says Guthrie, "was not a good authority, but his influence was wide and affected the practice of surgery."

M. Faure, a French surgeon, won the Surgical prize of the French Academy of Surgery, in 1762, determining in favour of delaying the operation of amputation in all cases in which it was practicable to do so.

Baron Larrey, who, like Guthrie, had great practical experience, was in favour of immediate amputation. He was Inspector-General of the hospitals of the French Army, and during his campaigns, and in his writings, he endeavoured to prove the great advantage of immediate amputation and to establish its superiority over that usually practised at a subsequent period. He was thus a powerful supporter of the views of Guthrie.

Mr. John Hunter, Inspector-General of the hospitals of the British Army in 1794, and indisputably the first surgeon of the age in which he lived, was against amputation on the field of battle, except that a patient after amputation can be moved with more ease without a limb than with a shattered one. Guthrie writes: "Mr. Hunter, whose great talents would have left nothing to be written on gunshot wounds, if he had had the same opportunities of acquiring knowledge on this subject as he had of others, has erred on a point that could only be decided by personal experience."

Guthrie on the Time at which Amputations should be done, with Illustrative Cases.

"If at the end of six hours after the injury the soldier has recovered from the general constitutional alarm occasioned, his pulse regular and good, his stomach easy—he is less agitated, his countenance revives and he begins to feel pain and stiffness—he will now undergo the operation with the greatest advantage. He will recover in nine cases out of ten in any amputation on the upper extremity or below the middle of the thigh without any bad consequences.

"If, on the contrary, the operation be performed before the constitution has recovered itself, he will die, for the additional injury will be most probably more than he can bear."

Operation done too soon.

"At the storming at Ciudad Rodrigo, I amputated a thigh in a convent close to the breach within an hour of the accident at the anxious desire of the patient, the leg having been destroyed by the explosion of a shell. At daylight the next day I found him dead."

Operation done at the Right Time.

"At the battle of Salamanca two men were brought to me about 4 p.m., one with his arm carried away at the shoulder and the other with the leg and knee smashed. They were very low. They were laid in a ditch, a little rum and water given to them during the night. At five the next morning they were much recovered and both were successfully operated on."

Guthrie's Final Conclusions.

"The objections to immediate amputation on the whole I consider to have arisen from theory, not practice, and they may, therefore, be disregarded. It is an error to consider that such cases cannot always be removed from the field. I removed an officer during the first siege of Badajos four hours after amputation at the shoulder joint a distance of thirteen miles."

"At the last siege of Badajos and that of Ciudad Rodrigo all capital operations were done on the field and afterwards sent to hospitals three to five leagues distant. No bad consequences occurred.

"Secondary hæmorrhage seldom occurs after primary amputation. Most cases dying of primary amputations die during the first twenty-four hours. In secondary amputation the state of health and other diseases, such as dysentery, militate against recovery." Guthrie allowed patients after serious operations a little brandy and water.

As in Malta in our experience, so in the Peninsula, some of the most promising of surgical cases died of other diseases, such as fever or dysentery.

The Method of Dressing Amputation Wounds.

Guthrie writes: "All that is necessary is to keep the edges forward. Baron Larrey agrees. To close the stump will cause much mischief and even death itself. If there is fever, whatever else you do, separate the flaps and dress the wound from the bottom."

I often wonder what Guthrie would have thought if his spirit had followed us round the wards during the invasion of Malta last year by thousands of wounded soldiers. I am sure he would have been pleased with our work, but I am equally sure that he would have taught us much from his great experience.

Though I remember the times of pus, septicæmia, pyemia and secondary hæmorrhage, very few of the vast number of keen medical officers of the Army had seen these things. Their experience and training was almost entirely limited to the experience of wounds and operations in which healing by the first intention was the rule. The maxims of Guthrie will remain at the outbreak of any war an invaluable guide to many a medical officer.

There are a great number of problems which still confront us in the

treatment of gunshot wounds. But progress, though slow, is sure, as witness the labours of many workers.

Perhaps it is more difficult in clinical medicine and surgery to reach truth than in many other sciences. Clough's lines represent well the difficulties which assail us—sometimes we miss obvious signs—sometimes we fail in our search for, or in our interpretation of hidden signs:—

> "Truth is a golden thread, seen here and there
> In small bright specks upon the visible side
> Of our strange being's party-coloured web.
> How rich the converse! 'Tis a vein of ore
> Emerging now and then on Earth's rude breast
> But flowing full below. Like islands set
> At distant intervals on Ocean's face,
> We see it in our course: but in the depths
> The mystic colonnade unbroken keeps
> Its faithway way, invisible but sure.
> Oh, if it be so, wherefore do we men
> Pass by so many marks, so little heeding?"

Since the commencement of the Great War we have all been treating the sick and wounded soldier.. Up to the present we have had some disasters and many great achievements. The wilderness of truth in the treatment of gunshot injuries is no longer pathless. Many of the glades of surgery are evergreen, and have been trodden by our predecessors. We must see to it that we do not take credit for what they accomplished. Of those who have contributed to the slow but certain progress of this department of surgery some, like Larrey and Guthrie, are known, but many are unknown to fame.

Though in this, as in every other branch of surgery and science, each stage in the advance of knowledge is associated with one or several great names which are interwoven in its history, we ought never to forget what is due to those of less renown—for any medical officer who has accurately observed and recorded an important fact—he also has added his stone to the building.

Review.

SHELL SHOCK AND ITS LESSONS. By G. Elliott Smith, M.D., F.R.S., and T. H. Pear, B.Sc. Manchester, at the University Press: Longmans, Green and Co. Pp. 132. Price 2s. 6d. net.

The aim of this small volume is to provide a brief and simple description of the group of nervous phenomena officially known as "shell shock," together with the measures requisite for its relief. As the authors point out, this symptom-complex is not new to medical science, but is already familiar in the ordinary "nervous breakdown."

The opening chapter is devoted to a general account of the nature of the condition and a few illustrative examples are given; these are regarded, quite correctly, from the psychological point of view. It is stated that although functional disturbances—mutism, paralysis, anæsthesias, etc., may be present, in the majority they are absent. This is somewhat contrary to general experience in military cases, especially with regard to anæsthesia.

Treatment, to some extent, naturally varies with each individual case. In general, however, the harmful effect of misplaced emotion and false sympathy is pointed out, and the all-important factor of confidence in the physician insisted upon. As regards hypnosis, the authors' experience coincides with our own—that it is useful in facilitating the removal of certain symptoms, but in itself is not sufficient to bring about general recovery. The method of treatment most favoured is that of "psychological analysis and re-education." An instructive explanatory account is furnished as to the term "psychological analysis," without the undue stress on the sexual side that characterizes the Freudian school. Many analogies are cited, but little or no practical advice given as to its method of application in the treatment of "shell shock." Since the authors, however, rightly maintain that treatment should be conducted by physicians specially experienced in early mental disorders, the reason for this omission appears obvious.

In the last two chapters, the chief object of the work becomes apparent. Attention is drawn to the entire lack of facilities for the treatment of incipient mental disease occurring in the civilian population, and a plea is put forward for the establishment of clinics where such patients, in many cases, would be saved from definite insanity. It is indeed grotesque that our country, so humane in most other matters, allows the early mental sufferer, who is unable to afford treatment by a specialist, to become certifiably insane before anything is done for him. No general hospital can take such cases and the asylum is closed to them until often it is too late. The authors do well to comment upon this serious matter; the deficiency has been recognized for years by the few, but, until remedied, cannot be pointed out too frequently.

The mental effects of war experience has stimulated both public and medical interest in nervous disorders and led to military cases being treated by humane and rational methods. Similarly, a more rational treatment of civil cases is required; it is sad to reflect that in this instance—the only one, let us hope—we are even less humane than Germany. The book serves a useful purpose in emphasizing these facts, as well as drawing attention to the inadequacy of our present asylum system. C. W. D.

Current Literature.

Gunshot Wounds of the Lung. Professor A. Borchard (*Volkmanns Sammlung klin. Vorträge*, No. 730, Chir. No. 200, Leipzig, 1917) gives a general account of the subject, based on his own experience and some twenty articles quoted from the recent German literature. He points out that most of the larger wounds of the chest-wall involving the lungs are immediately or rapidly fatal, and intimates that nine or ten per cent of all gunshot wounds involve the lungs, and that rifle or other bullet wounds account for sixty or seventy per cent of these. Describing the symptoms of gunshot wounds of the lung, he sets down the fever that habitually follows to infection in most cases, whether purulent or no; he does not believe in fever caused by the absorption of aseptic blood-clot from the lung. Hæmoptysis occurs in over ninety per cent of the cases; if there is no hæmoptysis, it is doubtful whether the lung has been wounded. Hæmothorax is said to occur in eighty-three per cent of the cases; the difficulty of making sure of the presence of a small hæmothorax without paracentesis of the chest is pointed out. In the case of large and increasing hæmothorax Borchard advises that the wound in the chest-wall should be enlarged until it admits the hand, and the bleeding point dealt with directly; excision of the wound in the lung itself is not recommended, but when possible the wound in the chest-wall should be sewn up. Hæmothorax in general should be dealt with by tapping on the tenth day and withdrawing about 200 cubic centimetres of the fluid in the pleural cavity; if this does not lead to reabsorption of the fluid, the tapping should be repeated. Borchard does not believe that the replacement of the fluid by gas (artificial pneumothorax) yields better results than simple tapping in these cases. He does not mention the use of early aspiration. For the treatment of open pneumothorax he recommends excision of the wound in the chest-wall and its sutures, unless an empyema is already present, when the insertion of a drainage tube is advised. Closed pneumothorax may be left untouched, unless it is of the valvular variety and leads to overfilling of the pleural cavity, when it

should be treated by the insertion of a valvular drainage tube. The general treatment of gunshot wounds of the chest consists in keeping the patient at rest and as quiet as possible; he should not be moved from hospital for two or three weeks; morphia should be given, and it has the advantage of lessening the tendency to cough. The patient should be placed in special wards free from cases of suppuration, and kept as free from dust as possible; comfortable beds should be supplied rather than sacks filled with straw, the wards should be sunny, and the air should be kept humid. Systematic lung-gymnastics should be begun as early as possible. Borchard agrees with other German authorities in estimating the occurrence of empyema in fourteen per cent of the cases reaching the hospitals far behind the lines; this complication demands very thorough surgical treatment. Pulmonary abscess is rare, and he has met with it seven times in about 500 cases; in one instance it occurred fifteen months after the gunshot wound. Pulmonary gangrene occurred in three out of 400 cases seen at the front. Troublesome sequelæ may follow these pulmonary injuries, some of them not very readily diagnosed. Thus pleural adhesions about the heart or diaphragm may lead to collapse on exertion, when the diagnosis of hysteria may be made. Borchard takes a rather gloomy view of the prognosis so far as return to full duty is concerned, but gives no figures of his own; he notes with surprise that Freund and Cayet have returned 86·7 per cent of their cases to full duty. He has seen quiescent tuberculosis of the lungs reawakened by gunshot wounds of the lung in many cases. As for shot and shell fragments in the lungs, he recommends their operative removal unless they are really inactive. In general these patients should be kept under careful observation for a long time before such operations are attempted by surgical experts.

The Immunization or Furnishing with Antibodies of Skin-flaps or Grafts. An address by Katzenstein. (*Berl. klin. Woch.*, No. 20, p. 490.)—He claims great results in the treatment of old skin defects which have hitherto resisted—even for two years—attempts at grafting. He applies to the skin that it is proposed to use for grafting purposes bandages soaked in the discharge from the wound or brings them in contact by other methods. Treated in this way the graft or flap rapidly takes root in spite of apparently highly unfavourable conditions.

"**On Wolhynia Fever.**" By Dr. Erich Rutter, Kiel. (*Berl. klin. Woch.*, No. 22, p. 526.)—This is evidently the same as our trench-fever—which the Germans also call five-days' fever. The main point is the stress laid on symptoms of spinal (meningeal or nerve root) irritation, particularly hyperæsthetic skin areas on the trunk having segmental distribution. This is not the same as the infective polyneuritis described in the *British Medical Journal* by Gordon Holmes, but it is a question if the two do not overlap.

Attempts to Substitute Gelatine for Proteid Food, the Gelatine being extracted from Hides, Bones, etc. By N. Zuntz. (*Berl. klin. Woch.*, No. 22, p. 540.)—The attempts proved fruitless on account of

the digestive disturbances set up in the animals so treated unless the gelatine were given in quite small quantities.

"Experiences with Trench Nephritis." By Wiedemann. (*Deutsche med. Woch.*, No. 20, p. 620.)—He concludes, as do our observers, that the condition is due to a glomerular nephritis. The following—under the head of treatment—is of some significance: "In cases with œdema salt-free diet is of course indicated, while in the rest there is not only no object in attempting a strict regulation of diet, but this might be actively harmful in view of the *extreme lowering of nutrition, which is unavoidable at the present time.*"

"On the Estimation of the Condition of the Heart and its Disturbances for Military Purposes." By Professor Treupel (not concluded). (*Deutsche med. Woch.*, No. 28, p. 678.)—Not informative except as showing that the same difficulties and the same ways of dealing with them exist in Germany as here.

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Original Communications.

NOTES ON MALARIA.[1]

By JOHN D. THOMSON, A.M., M.B., C.M.

From the Pathological Laboratory of the King George Hospital, July, 1917.

PART I.

THE intravenous route in the treatment of the active disease; technique employed and résumé of results obtained in fifty cases in which quinine bi-hydrochloride was given intravenously.

ADDENDUM.

Record of a case in which, during an afebrile period, tartar emetic was given intravenously.

PART II.

Incidents in the life-cycle of the parasites. (Plate.)

(*a*) Certain forms, or combinations, in the endogenous cycle of *Plasmodium vivax*; critical examination of the evidence put forward by Schaudinn in support of the so-called parthenogenesis theory to explain relapses; other views as to the manner in which relapses may be brought about.

(*b*) Initial stages in the exogenous cycle of *P. falciparum*; maturation of crescents, both male and female.

[1] This article was received in July, 1917.

INTRODUCTORY.

The following notes are based on observations and preparations made during the past nine months in the wards and pathological laboratory of the King George Hospital during the ordinary routine of general work. These observations have been rendered possible by facilities accorded by Lieutenant-Colonel R. C. Cottell, R.A.M.C., the Officer in Command, and by help received from various colleagues and from members of the nursing staff.

The patients admitted for malaria were mostly from Salonika, some were from Mesopotamia, and two were from Africa (one from the West Coast, and one from the East). In a few instances malarial relapses occurred in patients who had been admitted on account of wounds, or of other sicknesses. In upwards of a hundred cases in which parasites were found the parasite was that of quartan in one case only, of malignant tertian in nineteen, and of benign tertian in the remaining cases. The distribution in time was very uneven, as almost all the cases of malignant tertian were admitted in October of last year. In one case the parasites of both malignant and of benign tertian were present in the blood at the same time; and in a few others, in which "rings and crescents" were reported to have been found in Malta, only parasites of benign tertian were found while the patients were in the King George Hospital. Among the cases of benign tertian the presence of more than one generation of the parasite was perhaps the rule. Parasites belonging to different generations were frequently seen in the peripheral blood at the same time, and it was not unusual to find two generations equally active, separated in time by twenty-four hours, and giving rise to a quotidian type of fever. In some the number of red cells attacked was very large, and as many as six ring forms of the parasite have been seen in a single red cell. With two exceptions all were cases of relapse —the exceptions being cases of benign tertian that developed symptoms while the patients were under surgical treatment. One of these patients had been wounded in Mesopotamia, the other on the Struma front: but, so far as they knew, they had their first symptoms of malaria in the King George Hospital. The first case ran a quotidian type of fever for some time before its true nature was suspected. The second case was seen and treated during the first paroxysm, and will be referred to again in dealing with certain forms or combinations in the endogenous cycle of *P. vivax* under Part II.

I.—The Intravenous Route in the Treatment of the Active Disease.

The use of the intravenous route for the administration of quinine in malaria has hitherto been recommended almost exclusively for emergency cases, such as "pernicious comatose remittent," where rapidity of action is all-important. But the intravenous route has other and quite special advantages to recommend it in the treatment of malaria. It is the only route by which one can concentrate on the parasite in the circulating blood so as to obtain, within therapeutic limits, the maximum effect at the optimum time. Provided, then, that a safe and convenient technique can be recommended, the use of this route should be extended to many more cases of the active disease. In view of the importance of the subject at the present moment, I venture to explain a technique that I have found to be both safe and convenient, and to give a résumé of results obtained in fifty cases of malaria in which quinine bi-hydrochloride was given intravenously during the active stages of the disease.

Solution Used.—The strength of the solution used is twenty per cent. An ounce of quinine bi-hydrochloride is dissolved in, say, 120 cubic centimetres of normal saline, and the volume of the solution is then brought up to 160 cubic centimetres by the addition of more saline.[1] The solution is heated until it boils, and it keeps well in a glass-stoppered sterile bottle protected from direct sunlight. If not absolutely clear, the solution is passed through a sterilized cotton-wool filter, and each dose is again brought to the boil before being used. One cubic centimetre of the solution contains three grains of quinine bi-hydrochloride.

Technique Employed. — Before explaining the technique employed, I think it desirable to refer to a paper by MacGilchrist, entitled "Quinine and its Salts: Their Solubility and Absorbability." A summary of this paper appeared in *Paludism* (1911). My attention was called to it by Lieutenant-Colonel S. P. James, I.M.S., and its contents are probably familiar to members of the Indian Medical Service, and to others interested in the treatment of malaria. I refer to it now as I suspect that it may have unduly influenced some against the use of solutions of such strength as renders the intravenous administration of quinine generally

[1] The samples of quinine bi-hydrochloride supplied varied; and only those giving a clear solution were used. With some samples, the solution was more acid than with others, and in these cases the acidity was reduced by the addition of about 0·25 per cent soda bicarb.

practicable. Captain MacGilchrist considers that "quinine salts in the dilutions usually employed are quite unsuitable for hypodermic use," and that "this mode of administering quinine (subcutaneous including intramuscular) should be abandoned." His conclusions about the intravenous route as given in the summary referred to are as follows: "Great dilution (at least 1 in 150) is necessary in order to avoid the dangers special to quinine. Seven grains of quinine bi-hydrochloride should be dissolved in two or three pints of saline. This mode of administration is called for in cases of emergency, as in pernicious malaria with coma or other cerebral symptoms; and in such cases the extreme dilution affords the additional advantage of attenuating the toxins and favouring their elimination. In this dilution intravenous injections of quinine are quick and sure, and their action is not fleeting. They are attended by no risks peculiar to quinine, but only by those attendant on intravenous infusions generally. When there is a tendency to hæmoglobinuria the quinine alkaloid, instead of one of its salts, should be used."

Accepting the statement that "great dilution is necessary in order to avoid the dangers special to quinine," I believe that such dilution can be obtained *in the circulating blood* by attention to technique, even when comparatively strong solutions are used for injection.[1] The points I would emphasize are: select a good-sized

[1] Captain MacGilchrist's experiments relating to miscibility of quinine with blood serum apply chiefly to hypodermic and intramuscular injections. With proportions of serum much larger than he used, other results are obtained. Blood plasma *in vivo* is not the same as blood serum *in vitro*, but on mixing together a 20 per cent. solution of quinine bi-hydrochloride in normal saline with human blood serum in test-tubes in the proportions given below, and placing them in the incubator at 37° C., the results were as follows:—

Dilutions	After 1 min.	At end of 10 mins.	At end of 1 hour	Overnight
1 in 2	Clear; fluid ..	Opalescent; jelly-like	Opalescent; solid	Opalescent; solid.
1 ,, 5	Opalescent; fluid	Milky; fluid ..	Milky-white; solid	Milky-white; solid.
1 ,, 10	Slightly opalescent; fluid	Opalescent; fluid	Opalescent; fluid	Opalescent; viscid.
1 ,, 20	Less opalescent; fluid	,, ,,	,, ,,	Opalescent; fluid.
1 ,, 40	Very slightly opalescent; fluid	Slightly opalescent; fluid	Slightly opalescent; fluid	Slightly opalescent; fluid
1 ,, 80	Trace of opalescence; fluid	Very slightly opalescent; fluid	Very slightly opalescent; fluid	Very slightly opalescent; fluid.

In higher dilutions, 1 in 160, 1 in 320, etc., there was no change, the mixture remaining quite clear and fluid after being in the incubator overnight. Micro-

vein, use a sharp fine-bore needle, be sure that its point is well in the lumen of the vein, and inject the solution very slowly. The details, many of which, of course, may be modified by the individual operator, are as follows: Five or six cubic centimetres of the stock solution are brought to the boil in a test-tube. The patient is in bed, and lies on his back. The median basilic or other large superficial vein at the bend of the elbow is selected and the skin over it is painted with tincture of iodine. While this is drying, the quantity of solution to be injected is drawn from the test-tube into a sterile five-cubic-centimetre syringe fitted with a sharp sterile needle. When the syringe is charged with the solution a little sterile saline may be drawn into the needle. The nurse or assistant now grasps the patient's arm just above the elbow, lightly, but so as to compress the veins. If the patient now forcibly closes and opens his hand two or three times in succession, the veins at the bend of the elbow will stand out prominently. The secret of clean and easy puncture is a sharp needle and a prominent vein. When the needle enters the vein the pressure above the elbow should be removed. If the bore of the needle used is not very fine, and if pressure is not immediately removed, blood is apt to regurgitate into the syringe, and that should be avoided. On the other hand, a little blood should reach the nozzle (if necessary, be drawn into it) to show that the needle is in the vein. With the point of the needle well in the lumen of the vein the operator should maintain complete control over the injection. A needle of fine bore makes slow injection easy. From fifteen to twenty seconds should be occupied in injecting one cubic centimetre of the solution and a pause of some seconds made between each cubic centimetre. If this is done, one or two rounds of the circulation will have been completed before a full dose is given. Singing in the ears and other symptoms due to the action of quinine begin usually by the time that six to nine grains of the quinine bi-hydrochloride have been injected. The operator should so control the injection that he can pause or stop at any stage he pleases. I have not yet had occasion to give less than nine grains, nor have I ever given more than fifteen grains of the bi-hydrochloride at one time. Before withdrawing the needle a little blood may be drawn into its bore to replace and so to

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scopically examined the 1 in 10 and 1 in 20 dilutions seemed to be emulsions of fine amorphous granules, probably of albumin or other protein of the serum. In the 1 in 40 dilution, in addition to fine amorphous granules, fine needle-like structures (probably quinine) about ten microns in length, and a fraction of a micron in width were seen.

prevent any leakage of the quinine solution into the tissues; but with a needle of fine bore this is unnecessary. As the needle is withdrawn, the patient's arm is slightly raised and no blood escapes. The puncture may be touched with tincture of iodine, but no dressing of any kind should be necessary. The requirements are about the same as for an intramuscular injection, and the process is much less painful to the patient. If the injection has been strictly intravenous no local reaction follows. In considerably over 100 injections I have only once seen local trouble, and that followed on hypodermic rather than on intravenous injection. A small area of thin skin necrosed and secondary infection through the necrosed area set up an acute cellulitis. The vein was not involved. The cellulitis subsided and ended with the discharge of seropus and a few connective tissue sloughs, after which healing was uneventful. In other two cases, when using a rather acid solution a mild subacute local phlebitis followed, but this was scarcely sufficient to attract the patient's attention, and entirely subsided in two or three days. One was a cardiac patient with unhealthy vessels, and in the other the injection had been made into a rather small vein in the forearm. As regards general reaction, if the injection is kept well under control, and if the solution is injected very slowly with frequent pauses, there should be no symptom to cause the slightest anxiety. A nervous patient may show signs of hysteria, even to the "globus hystericus," while the injection is being made, but if the pulse remains good there is no cause for alarm. Special precaution should be exercised in dealing with cardiac cases in some of which intravenous injection may be altogether contra-indicated; but in general, in these and in other cases the special precautions are concerned with dosage and with individual idiosyncrasy, and apply equally to other modes of administering quinine.

Résumé of Results obtained in Eighteen Cases of Malignant and in Thirty-two Cases of Benign Tertian in which Quinine Bi-hydrochloride was given Intravenously during the Active Stages of the Disease.

The results of the injections on the patients were noted clinically, and the effect on the parasites was observed by examination of blood films.

(*A*) *Malignant.*—Of the eighteen cases all but three had taken quinine prophylactically for longer or shorter periods before the first attack began. Some of the earlier cases, admitted in October,

1916, continued to have remittent fever and to have "ring" forms of *P. falciparum* in their blood, notwithstanding that they had taken large quantities of quinine and were still taking (some days after admission) ten grains of the hydrochloride in solution every eight hours by the mouth. The bowels had not been neglected, and the patients had been in bed since admission. In these cases the exhibition of quinine by the mouth was stopped for a day, and, in place of it, fifteen grains of the bi-hydrochloride were given intravenously in the manner already described. The results were so satisfactory that thereafter every case of remittent fever in which "ring" forms of *P. falciparum* were found in the peripheral blood was given fifteen grains of quinine bi-hydrochloride intravenously as a preliminary to further treatment. Altogether eighteen cases of "malignant tertian" were treated in this way, and the results of the injection were the same in every case. The attack was broken. The patient on the day following the injection invariably expressed himself as feeling very much better, his temperature had fallen to below the normal line, and "ring" forms of the parasite, though frequently present in very small numbers on this day, could not be found by the end of the second day in films of the peripheral blood. On the day following the injection, quinine was begun, or continued, by the mouth; and ten grains of the hydrochloride in solution every eight hours were now sufficient to keep the temperature down, even though similar doses may have failed to reduce it before the injection was given. Although "ring" forms of the parasite disappeared from the peripheral blood, crescents remained as before. In one case, after an attack had been broken by the intravenous injection of fifteen grains of quinine bi-hydrochloride, no quinine was given by the mouth, but intravenous administration was continued for three days longer—nine grains on the second, twelve grains on the third and on the fourth days—and the blood was examined for crescents up to a week after the last injection had been given. On each occasion crescents were found. A day or two later (nine days after receiving the last injection) the patient had a relapse. I saw him soon after it began. His temperature was then just over 100° F., he was vomiting bile, and many "ring" forms of the parasite, together with a few crescents, were found in a film of blood taken from his finger. After finding the "rings" no time was lost before giving him an intravenous injection containing fifteen grains of quinine bi-hydrochloride. Some hours later he felt quite comfortable. He had a good night, and next morning he felt quite well,

and his temperature was below normal. The attack was broken, and further treatment was now continued by the mouth. At the end of a fortnight one more intravenous injection containing twelve grains of quinine bi-hydrochloride was given, and after that a mixture containing iron, arsenic, and nux vomica was added to the treatment by the mouth. Crescents were still present in the peripheral blood at this time, but a fortnight later, i.e., a month after the relapse, none could be found in thick dehæmoglobinized films taken on four consecutive days. The patient had then been up for a week. He felt well, and looked very much better than he did when he was admitted. He was then transferred to a Convalescent Hospital. Being a dispenser in the Royal Army Medical Corps, the history he gives is interesting in its bearing on quinine administration:—

His first attack began on October 1, 1916. For three months previous to this (from July 1 till the beginning of the attack) he had taken five grains of quinine sulphate in solution daily. The attack began with a rigor and with bilious vomiting. He was treated in hospital (in Salonika), and during each of the first four days he got ten grains of quinine intramuscularly and thirty grains by the mouth. Notwithstanding treatment, bilious vomiting, rigors and exacerbations of temperature continued daily for three successive days. He cannot say how long his temperature remained up, but bilious vomiting ceased after the third day. At the end of four days intramuscular injections were left off, but quinine by the mouth was continued for three weeks longer—thirty grains in solution daily. After this course of treatment he returned to duty, but, four days later, another attack began and he was sent back to hospital at once. This attack was practically a repetition of the former one. Bilious vomiting was pronounced, and, as before, continued for three days, in spite of treatment. He remained in hospital for a month, and, during that time, took thirty grains of quinine in solution, daily, by the mouth. He again returned to duty, but felt ill all the time, and at the end of three weeks he was sent to Malta. He remained in Malta from January 1 till March 12. During that time he had two attacks, each of which began like the two former attacks, and bilious vomiting continued as before for three successive days, in spite of treatment. While in Malta he took fifteen grains of quinine daily for seven weeks on end, and had then to discontinue on account of irritation of the stomach and deafness. On arrival in England he was sent to the King George Hospital. He was then emaciated and sallow. His spleen was palpable, and during the attack which began on March 27 was tender. As previously stated, both attacks which he had while in the King George Hospital began with shivering and bilious vomiting, just as previous

attacks had begun, but each was cut short on the first day by an intravenous injection containing fifteen grains of quinine bi-hydrochloride given soon after the attack began.

After being in convalescent hospital for nearly seven weeks this patient had a rigor and rise of temperature, followed by sweating, but he did not suffer from bilious vomiting or from sickness. He took quinine by the mouth. Two days later he had another similar paroxysm. He continued to take quinine by the mouth, and returned to the King George Hospital. I examined his blood on arrival, and found only gametocytes of benign tertian. When in this hospital before he went to the convalescent, no parasites of benign tertian were ever found in his blood, only those of malignant tertian.

Another case in which galyl was first given is worth referring to:—

In this case a full dose of galyl was given intravenously by one of the physicians while "ring" forms of *P. falciparum* were present in the peripheral blood. I examined films of the peripheral blood daily for three days after this injection. Neither "ring" forms of the parasite nor the patient's temperature seemed to be influenced in the slightest degree, so at the end of three days I gave him twelve grains of quinine bi-hydrochloride intravenously. On the following morning his temperature was below normal, he felt well, and "ring" forms of the parasite had all but disappeared from the peripheral blood. In films taken on the day after no "ring" forms were found. The patient had an after course of treatment, beginning on the day after the injection, similar to that given to the case mentioned above. Up till three weeks from the day he had the intravenous injection of quinine and while still taking quinine by the mouth, crescents were found in the peripheral blood. Since then I have several times examined his blood for crescents without finding any. He has not yet had another relapse, and has steadily improved in condition, so that now (five months later) he feels and looks very much better.

(*B*) *Benign Tertian*.—The thirty-two cases of benign tertian chosen for intravenous injection were most of them severe cases. In many, parasites of two generations were about equally numerous in the blood at the same time giving rise to a quotidian type of fever. The great majority had had several relapses, and each had, since the first attack, taken large quantities of quinine. Some during former attacks had been given quinine intramuscularly as well as by the mouth. Most had had more than one course of hospital treatment, varying from three weeks to three months at

a time—the longer periods including treatment in convalescent camp or convalescent home. A few had been in many hospitals and had had long courses of quinine by the mouth. Others had been having constantly recurring attacks, and these as a rule had not taken quinine during the afebrile intervals, but had taken it by the mouth up to thirty grains a day for five or six days at a time while fever lasted. All but six had taken quinine prophylactically for longer or shorter periods before the first attack. Five of these six had had many relapses and were severe cases, although the treatment they received from the time of the first attack did not differ from that received by others who had taken quinine prophylactically before their first attack.

To the majority of cases of benign tertian the quantity of quinine bi-hydrochloride given in each intravenous dose was twelve grains. This dose was arrived at as a result of comparing the effect on the parasites in different cases as ascertained by examination of blood films taken before and after doses of 9, 12, and 15 grains. By the examination of films in a number of cases in which the dose was repeated an endeavour has also been made to ascertain when and how often the dose should be repeated in any given case. In every case the first injection was given during a paroxysm, usually at the end of the hot stage or just as the skin began to get moist and the temperature began to fall. If given at the beginning of the hot stage, the quinine would probably add to the patient's discomfort. In two cases I had an opportunity of giving the dose at the very beginning of the rigor. In both cases, according to the patients' statements, the rigor seems to have been shortened, while the hot stage was proportionately lengthened. In every case the first intravenous injection was sufficient to break the attack, so that the paroxysm next in order did not occur. This was so even in cases where two generations of the parasite were present in the circulating blood, and where a quotidian type of fever was to be expected. Unlike the crescents of malignant tertian, the gametocytes of benign tertian disappear from the peripheral blood under the direct action of quinine. But although quinine affects all stages of *P. vivax* present in the circulating blood, examination of films shows that all stages are by no means equally affected. In this connexion the following cases may be quoted:—

(*a*) When only one generation of the parasite was seen to be active, the patient got in all three intravenous injections of twelve grains each.

Case 1.—In this case the first injection was given *during a rigor*, and the second and third injections on alternate days when the two rigors next in order would have been due, had the case remained untreated. Examination of films :—

(1) Films taken immediately before the first injection was given. Gametocytes (male and female) fairly abundant : some schizonts with nucleus dividing and others where schizogony is completed, seen ; many young trophozoites present—some, disk-like, clinging to red cells, and other "ring" form.

(2) Film taken twenty-six hours after the first injection was given. A few gametocytes present. No other forms of parasites seen.

(3) Film taken forty-eight hours after first injection was given. No gametocytes nor other form of parasite seen.

(4) Film taken twenty-four hours after second and just before the third injection was given. No parasite seen.

Case 2.—In this case the first injection was given at the *end of the hot stage*, and the second and third injections at the same time on alternate days. Examination of films :—

(1) Film taken just before the first injection was given. Gametocytes fairly numerous : fully divided schizonts and many young "ring" trophozoites seen.

(2) Film taken just before the second injection (i.e., forty-eight hours after the first) was given. No parasite seen.

(3) Film taken just before the third injection was given. No parasite seen.

Case 3.—In this case the first injection was given *during the sweating stage*, and the second and third injections on alternate days when the two "rigors" next in order would have been due had the case remained untreated. Examination of films :—

(1) Film taken just before the first injection was given. Many young trophozoites, mostly "ring" forms, and a fair number of gametocytes (male and female) present. No other forms seen.

(2) Film taken just before the second injection (about forty-two hours after the first) was given. A few gametocytes (male and female) present, and one schizont seen.

(3) Film taken just before the third injection was given. No parasite seen.

(*b*) When two generations of the parasite were seen to be active, and a quotidian type of fever, reported or expected, each generation was considered separately, so that the patient got six intravenous injections, one on each of six successive days.

Case 4.—This case had been having constantly recurring attacks and was seen during the first paroxysm of a recurrence—about the end of the hot stage, 5½ hours after the rigor began. Examination of films :—

(1) Film taken just before the first injection was given. Many gametocytes (male and female), many young "ring" trophozoites and also many half-grown, actively amœboid trophozoites present.

(2) Film taken just before the second injection (about eighteen hours after the first) was given. Gametocytes (male and female) present, also a fair number of very young trophozoites, mostly disk forms, clinging to the surface of the red cells. Some half-grown trophozoites are also present, but most of these are solid-like, suggesting that they may be half-grown gametocytes. A very few are amœboid, and some are fragmenting.

(3) Film taken just before the third injection (twenty-four hours after the second) was given. No parasite seen.

(4) Film taken just before fourth injection was given. No parasite seen.

Case 5.—This case had had daily paroxysms for eight days before admission.

(1) Film taken three-quarters of an hour before the first injection was given. Many gametocytes (male and female), many fully divided schizonts, a large number of young "ring" and of half-grown actively amœboid trophozoites present.

(2) Film taken just before the second injection (about twenty-three hours after the first) was given. A fair number of gametocytes (male and female), also a fair number of schizonts with nucleus dividing and some young "ring" trophozoites present. No half-grown amœboid forms seen.

(3) Film taken just before the fourth injection (about twenty-four hours after the third and forty-eight hours after the second) was given. One gametocyte and no other form of parasite seen.

(4) Film taken just before the fifth injection was given. No parasite seen.

The merozoites free in the plasma and the young disk-like forms clinging to the surfaces of red cells are probably more directly exposed to the action of the quinine, but the young "ring" trophozoites are perhaps equally vulnerable. The "ring," or rather the "hollow-sphere" form, giving a large absorptive surface in proportion to the mass of the parasite, is said to be (and probably is) an adaptation to quick nutrition and rapid growth, but it also renders this form of parasite more vulnerable to quinine. The half-grown actively amœboid forms are seen (Case 4 and Case 5) to be affected to a less degree than the small "ring" forms, and the gametocytes are affected least of all. Thus the action of quinine on the various forms of the parasite present in the circulating blood seems to be in direct proportion to their nutritive activity. The time to con-

centrate against the parasite, therefore, is during the paroxysm, when schizogony has taken place and before the young trophozoites have passed the "ring" stage. The period covered by schizogony varies in different cases, but, roughly speaking, it extends from the beginning of the rigor to quite the end of the hot stage. If quinine is given intravenously during the rigor no great quantity is likely to be eliminated before the end of the hot stage, so that theoretically it should have its maximum effect on the cycle if given then. On the other hand, very few of the young trophozoites will have passed the "ring" stage before the patient's temperature begins to drop, so that the patient's comfort will be considered without the parasite being spared if the first intravenous injection is given at the very end of the hot stage or just as the skin begins to get moist. Subsequent intravenous injections should be timed for what would have been the end of the rigors or the beginning of the hot stage in the paroxysms next in order had the case remained untreated. The large majority of these thirty-two cases of benign tertian were treated in this way, and after giving three intravenous injections for each generation causing, or likely to cause, paroxysms, a modified course of treatment with quinine and including iron, arsenic, and nux vomica, by the mouth was recommended for some weeks longer. I have not heard that any of these cases have relapsed, but even if none have, the time that has elapsed is too short to allow of any deduction being drawn from that circumstance. In some of the thirty-two cases, only one intravenous injection was given in order to break the attack, and quinine was then continued by the mouth. In other cases quinine was given intravenously only, and the results were compared with the reported results of former attacks, when quinine was given intramuscularly and by the mouth, or by the mouth only. In all these cases the results were very much in favour of the intravenous route. The first dose of twelve grains invariably broke the attack, the total quantity of quinine given was very much less than formerly, the patients' appetites improved, and they felt better than they had done under any former treatment. Some of these cases left the hospital within a fortnight and have not been heard from since, but two cases that had been having constantly recurring attacks before admission may be mentioned. These cases are here designated Case 6 and Case 7.

Case 6.—This patient had his first attack on July 28, 1916—two weeks after his arrival in the Struma Valley. He had not taken quinine before this attack. After the attack he was treated in Salonika for three

weeks, getting quinine by the mouth t.d.s. and was then sent to Malta. In Malta, from August 4 till 11, he got quinine in solution ten grains t.d.s. From August 11 till September 1 he got altogether twenty intramuscular injections of quinine, ten grains in each, in addition to quinine by the mouth. On August 19 it is reported that "crescents" were found in his blood. He left Malta on October 13, and arrived in England on October 26. He did not have any quinine on the voyage, but on arrival was sent to hospital in Devonport, where he had a "rigor," and was treated with quinine by the mouth. After a week he was sent to a convalescent home, where he remained three months; had two or three "rigors" every week, he says, until the last fortnight. He was then moved to another convalescent camp, and during ten days there he had three paroxysms, two of them on consecutive days. From camp he was sent to hospital, where he got thirty grains of quinine in solution daily by the mouth (ten grains t.d.s.) for six days. On returning to camp he had two more paroxysms and was sent home on sick leave. While at home he had daily "rigors" for five days. During this time he took quinine in tabloid form ten grains daily, then in liquid form twenty grains daily. On returning to his depot he had four more paroxysms, and on his way home again he took ill in the train, and was brought to the King George Hospital. Examination of blood film showed that two generations of the parasite of benign tertian were active. He was given fifteen grains of quinine bi-hydrochloride intravenously at the beginning of the sweating stage, and ten grains on the following day, when the paroxysm due to the other generation of parasites would probably have occurred. No further treatment was given. Two days later no parasite could be found in films of the peripheral blood. The patient said he felt better than he had ever done under former treatment. His appetite and his general condition rapidly improved. He remained in hospital for twelve days, being up and helping in the ward during the last week. He left feeling well, but not long after I heard that he had another attack.

Case 7.—In this case, also, no quinine had been taken before the patient had his first attack, but treatment was begun immediately the attack occurred. In Malta, he says that he took quinine by the mouth every four hours night and day for five weeks on end. Before he came to the King George Hospital he had been having attacks which lasted four or five days at a time at intervals of about five days. He took no quinine during the intervals between the attacks, but took ten and twenty grains daily during the attacks. A week before he was brought to hospital suffering from a paroxysm, he had had an attack which lasted five days, and during those five days he took thirty grains of quinine in solution daily by the mouth (ten grains t.d.s.). Two generations of parasites were found present in his blood on admission. He got, in all, three intravenous injections of quinine bi-hydrochloride—fifteen grains

in each. The first was given during the sweating stage, the second forty-eight hours later, and the third twenty-four hours after the second. He left hospital feeling well, but I heard from him later that he had another attack, which began on the twenty-fifth day after he had received his last injection.

In considering recurrences, the possibility of multiple infection must not be forgotten. Thus in two cases that had recurrences while the patients were still in hospital, the recurrences took place on days that did not correspond with the forty-eight hours cycle of the generations that were attacked by the intravenous injections. The first, which we will call Case 8, had a severe rigor on the morning of April 22. The rigor began about 6 a.m. At 8 a.m. his temperature was 106·4° F. He got an intravenous injection of twelve grains quinine bi-hydrochloride at 10.50 a.m. His skin was then moist and his temperature was 105·4° F. On April 24, at 10.30 a.m. he got another injection of twelve grains, and this was repeated about the same time on April 26. After the first injection he did not have a paroxysm until May 11. The rigor began about 11 a.m. This attack was at once cut short by an intravenous injection of twelve grains of quinine bi-hydrochloride given at the end of the hot stage or just as the skin began to get moist. Had this attack been a recrudescence the 10th or the 12th would have corresponded with the last attack, but not the 11th of May. It might be argued that in this case the fever either *anticipated* or *postponed*, but the hypothesis that the recurrence was a relapse due to a generation that was quiescent when the patient was treated for the preceding attack cannot be ruled out, especially as more than one generation of parasites were now seen in the blood film examined. In Case 9, in addition to many "ring" forms, one or two half-grown amœboid trophozoites were seen in films of the peripheral blood taken just before the first intravenous injection was given. On April 20 this patient had a rigor which began just before noon. He got twelve grains of quinine bi-hydrochloride intravenously at the end of the hot stage, and this was repeated about noon on the 22nd and again on the 26th. He did not have a paroxysm after the first injection until May 11. The rigor on May 11 began about noon. In this case the recurrence was probably caused by the generation represented by the one or two half-grown trophozoites seen in the film taken just before the first intravenous injection was given. In a third case, one already referred to (p. 387), there can be no doubt whatever about the recurrence being a relapse due to a generation that was

quiescent when the patient was treated for the preceding attack, because in this case the parasite causing the relapse was that of benign tertian, while in the preceding attack it was that of malignant tertian.

Case 9, referred to above, is interesting from another standpoint. He had a very large spleen extending to beyond the umbilicus and filling up a large part of the left flank. His first attack of malaria occurred in September, 1916. He had taken quinine prophylactically throughout the previous summer, and remained on duty after his first attack until towards the end of December, when he was sent to hospital suffering from pains in the bowels and enlarged and tender spleen. In Malta, no malarial parasites were found in his blood, and the question of kala-azar and splenic puncture was raised. Splenic puncture was not done. In hospital here, before he had the rigor on April 20, he had been taking quinine irregularly by the mouth and his temperature was irregular. During this period I found parasites of benign tertian in his blood on three occasions. He had an impression that quinine was responsible for all his troubles; but after the first intravenous injection, given on April 20, he was quite keen to have another. At this time, apparently, he did not realize that it was quinine that was being injected, for when the next attack began on May 15 he was very much averse to quinine but was quite eager to have the "injection."

Summary and Conclusions.

(1) The intravenous route has special advantages in the treatment of malaria during active (as distinguished from quiescent) periods of the disease. By this route, and at these times, the full quantity of quinine given can be concentrated against the parasite at the moment when it is most susceptible to its action; and the maximum effect of the drug, within therapeutic limits, can thus be obtained.

(2) By attention to a simple technique, quinine bi-hydrochloride in twenty per cent solution can be safely and conveniently given intravenously up to fifteen grains of the salt for a dose—a five-cubic-centimetre syringe and a suitable hypodermic needle being the only special apparatus required.

(3) In eighteen consecutive cases of malignant tertian with remittent fever and with ring forms of *P. falciparum* present in the peripheral blood, a single intravenous injection of fifteen grains of quinine bi-hydrochloride in twenty per cent solution was sufficient to break

the attack in every case; and once the attack was broken doses of quinine by the mouth which had been insufficient to reduce the temperature were now sufficient to keep it down. Ring forms of the parasite quickly disappeared from the circulating blood after the injection, but crescents were not directly affected.

(4) In all these cases of malignant tertian with remittent fever the intravenous injection was given as soon as ring forms of *P. falciparum* were found in the peripheral blood, i.e., as soon as the true nature of the fever was known.

(5) In thirty-two consecutive cases of benign tertian a single intravenous injection of twelve grains of quinine bi-hydrochloride in twenty per cent solution given during a paroxysm was sufficient to break the attack so that the paroxysm next in order did not occur. This was so even in those cases where a quotidian type of fever was to be expected.

(6) All stages of the schizogonous cycle of *P. vivax* present in the circulating blood were directly affected by the injection, but not to the same extent. The young forms before they pass the ring stage were most affected, then the actively amœboid forms, and others apparently in proportion to their nutritive activity. Gametocytes were the last forms of the parasite to disappear from the peripheral blood.

(7) The mature gametocytes of *P. vivax*, unlike those of *P. falciparum*, disappear from the peripheral blood under the direct action of quinine bi-hydrochloride given intravenously.

(8) In cases of benign tertian, the patients' comfort will be considered without the parasites being spared if the first intravenous injection be given at the very end of the hot stage. Subsequent intravenous injections should be timed to be given at what would have been about the beginning of the hot stage in the paroxysms next in order had the cases remained untreated.

(9) The intravenous injection of a twenty per cent solution of quinine bi-hydrochloride in normal saline in the doses and at the times stated can be relied upon to break promptly an attack of malaria; and, although immediate sterilization or even sterilization after any single course of treatment in cases that have already relapsed several times is not to be expected, it is reasonable to suppose that, if each relapse is cut short on the day of onset, the patient will stand a much better chance of ultimate sterilization; and that the shorter the time that the parasite is allowed to go on multiplying the less will be the risk of secondary changes due to the

activity of the parasite, and the greater will be the chance of quick and complete recovery.

ADDENDUM.

Record of a case, in which, during an afebrile period, tartar emetic was given intravenously:—

Rogers (1917) tentatively suggested that after the malarial paroxysms had been checked by quinine, "tartar emetic should subsequently be given intravenously, in the hope that it may prove of value in destroying the extracorpuscular stages of the malarial parasites, and so prevent relapses, and greatly lessen the infectiveness of the patient to malarial-bearing mosquitoes, by killing the crescents of the malignant tertian variety and the corresponding resisting forms of the other types of malaria."[1]

On February 28, 1917, a patient who had suffered from malaria was given six centigrammes of tartar emetic intravenously during an afebrile period when crescents were the only forms of parasite present in films of his peripheral blood. Films taken thirty-six hours afterwards showed quite as many crescents as did those taken just before the injection was given. Crescents were never very numerous, but could easily be found in thick dehæmoglobinized films, and, by searching, one or two could always be found in ordinary thin films. For some days after the injection his blood was examined daily, and crescents were found on every occasion. On March 9, i.e., on the ninth day after the first intravenous injection of tartar emetic, a second injection containing eight centigrammes was given. In a film taken immediately before the second injection was given, crescents were found as before; but in addition, gametocytes and trophozoites of the parasite of benign tertian were now present. This was the first indication we had that the patient had suffered from a mixed infection—from benign as well as from malignant tertian. On March 10, crescents were still present as before, and the parasites of benign tertian had increased in numbers. On March 11, he felt slightly chilly, and

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[1] In the same communication Rogers speaks of *the extracorpuscular cycle* "which," he says, "is responsible both for the frequent relapses of the ague and . . ." It is evident that by "the extracorpuscular stages of the malarial parasites" and by "the extracorpuscular cycle" Rogers means the gametocytes as present in the blood; but the term *extracorpuscular* as applied to them is quite inaccurate; and his definite statement that they are responsible for relapses will be looked upon by many who consider that this is still "sub judice" as being too arbitrary.

ripe schizonts in various stages of schizogony up to fully divided forms were seen, along with young trophozoites and with gametocytes of benign tertian as well as with crescents, in the films taken at this time.

In this case, then, if one allows for the incubation period, it would appear that the first dose of six centigrammes of tartar emetic given intravenously, in place of killing crescents, produced or hastened on conditions favourable to the onset of a relapse of benign tertian whose latency had not previously been suspected; while the second dose of eight centigrammes, given nine days after the first, neither arrested the development of the relapse of benign tertian nor did it act injuriously on the crescents.

II.—Incidents in the Life-cycle of the Parasites. (Plate.)

(*a*) Certain forms, or combinations, in the endogenous cycle of *P. vivax:* critical examination of the evidence put forward by Schaudinn in support of the so-called parthenogenesis theory to explain relapses; other views as to the manner in which relapses may be brought about.

It is not yet known in what way, or in what form, the parasite survives the long periods that may elapse between relapses. There has, nevertheless, been a good deal of speculation as to the manner in which relapses are brought about. The view that undoubtedly has held the foremost place for the longest time is what is best known as Schaudinn's parthenogenesis view. Grassi had suggested the possibility of explaining relapses by parthenogenesis of gametocytes, but it was Schaudinn (1902) who is supposed to have demonstrated its actual occurrence, and to have proved that this is the normal manner in which relapses are brought about. This view assumes that only female gametocytes (or sporonts) survive the healthy intervals between relapses. They are supposed to maintain their existence in a "resting state"—a state that is normal to them while they remain in the vertebrate host—if not in the peripheral blood, which is their natural place when fully grown, then somewhere in the deeper organs; but under certain imperfectly known conditions that favour a relapse they are supposed to "multiply parthenogenetically and produce a brood of merozoites, which are the starting point of a fresh series of schizogonous generations." No serious examination of Schaudinn's argument and of the evidence he adduces in support of this view has, apparently, been undertaken. Harrison (1909) published a paper

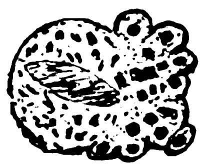
accompanied by a coloured plate supposed to support the parthenogenesis view, but I mention it only to give the reference. Thayer (1907) in his article on "Malaria" in Allbutt and Rolleston's "System of Medicine," having divided relapses into those *at short intervals,* and those *after long intervals,* writes: "It is not impossible that these late relapses may be due to parthenogenetic segmentation of macrogametes, such as has been described by Schaudinn. We have seen appearances exactly similar to his." Minchin (1912) defines parthenogenesis as "the power to develop without syngamy possessed by a sexually differentiated gamete, which under normal circumstances could do so only after syngamy with a gamete of the opposite sex. To this it must be added that the gamete which has this power is always the female."

Although parthenogenesis is said to be common among metazoa it would appear that the chief evidence of its occurrence among protozoa is the evidence adduced by Schaudinn in the case of *P. vivax* which we are to examine. We cannot therefore look for general evidence in support of the special case. But the special case in this instance, even if Schaudinn's interpretations of his figures be right, is not an example of parthenogenesis as defined above. Strictly speaking the term parthenogenesis would apply only if the female gamete without syngamy went through its *exogenous* cycle and not if it reverts to a schizont and goes through the *endogenous* cycle. The latter may still be true, but would not be evidence of parthenogenesis among protozoa.

Coming now to an examination of Schaudinn's original figures as reproduced in colour, I must refer the reader to the Plates that accompany his work on *P. vivax* (1902). But before examining his figures in detail I wish to point out that those he interprets as reversion (Rückbildung) and schizogony of the female sporont (macrogamete) are all from preparations made *within forty-eight hours before the actual paroxysm* of a relapse three and a half months after the previous attack. To expect to find forms that initiate the series of schizogonous cycles of a relapse at that stage seems to be quite as unreasonable as to expect to find sporozoites on the twelfth day of the normal incubation period of a first attack. That he should have done so is all the more astonishing as he had been examining the blood of this particular patient for days before. During his earlier examinations he had found gametocytes only; then nearer to the actual paroxysm he found in addition to gametocytes a few young trophozoites (ring forms); and lastly, forty-eight hours before the paroxysm, he found these forms which he

pieced together, building up a structure to explain relapses, which, under the name of parthenogenesis, has enjoyed a reputation which to this day has never been seriously disputed.

Schaudinn recognized that among double infections of red cells one of the forms might be a schizont, and the other a sexual form. This he illustrates by figs. 90 to 93, Plate V, accompanying his work on *P. vivax*. Figs. 90 to 92 show growing forms, each form separate and distinct from the other, so that their identity could not possibly be mistaken. Fig. 93 from a film taken during the height of a paroxysm (the fifth of an attack) shows a schizont divided up into merozoites in combination with a practically full-grown male gametocyte. If this figure be compared with fig. 110, Plate VI, where schizogony has reached a similar stage, but which, according to Schaudinn, represents schizogony of a macrogamete, the only structural difference seems to be that in fig. 93, Plate V, the gametocyte is a male, while in fig. 110, Plate VI, it is a female. Text



TEXT FIG. 1—Being tracing of Schaudinn's fig. 93.
[All Schaudinn's figures were magnified about 2,250 times linear.]

fig. 1, a tracing of fig. 93, is introduced here so that it may be compared with text fig. 8, but as these text figures are introduced simply to facilitate description the reader is again referred to Schaudinn's original reproductions.

Believing then that Schaudinn misinterpreted his findings I will now endeavour to give a natural explanation of why gametocytes are the earliest forms to be found in relapses, while in normal first attacks they do not usually appear before two or three paroxysms have taken place; and to show how Schaudinn's figures may be interpreted quite naturally in accordance with established facts without the necessity of bringing forward a hypothesis, which, to say the least, would require a good deal of extra evidence to establish its probability.

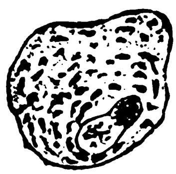
Passing over relapses *at short intervals* because the early presence of gametocytes in such cases requires no special explanation, I may say that in every case of relapse *after a long interval*

in which I have examined the blood during the first paroxysm of the relapse, I have found gametocytes, male as well as female, present in ordinary films of the peripheral blood. I found them also during the first paroxysm of a very long delayed first attack of malaria fever (about eight months after the patient had left a malarious district). Figs. 29 and 30 (Plate) show a male and a female gametocyte from this case. In the case referred to under Addendum, Part I, I found gametocytes along with schizonts two days before the first slight febrile manifestations of a relapse of an unsuspected benign tertian infection occurred. Schaudinn, as mentioned above, found them earlier still, though well within the possible incubation period of the relapse, and to begin with they were the only forms of the parasite he found. It is not necessary, however, to imagine that gametocytes found at those early stages of a relapse must have survived the long healthy interval that may have elapsed since the former attack. In normal first attacks, gametocytes, it is said, are not usually found before two or three paroxysms have taken place. The reaction of the host against the parasite is said to stimulate the production of the propagative phases. This is the same as saying that provision is made for the continuation of the species when the environment begins to be unfavourable to the life of the individual; and following, as it does, a much wider general law, this explanation may be accepted as correct so far as it goes. But in the case of a relapse the conditions are reversed. Here it must be assumed that the environment from being less favourable is becoming more favourable to the individual, and therefore, apart altogether from the question of what may be the starting point of the fresh series of schizogonous cycles, it is to be expected that a large proportionate number of gametocytes would be produced during the earlier generations of the series, more especially if the change from unfavourable to favourable, whatever it may be, is gradual and prolonged. If quick and complete, it is conceivable that gametocytes would not be found at the beginning of a relapse any more than at the beginning of an ordinary first attack; but, as said above, gametocytes have been present during the first paroxysm of all the cases of relapse that I have so far examined.

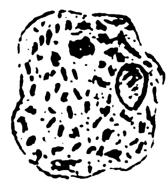
Schaudinn's figures, which he interprets as stages in the schizogony of macrogametes, arrange themselves quite naturally into two groups.

The first group comprises figs. 104 to 106, and deals with changes in the nucleus of macrogametocytes, which Schaudinn

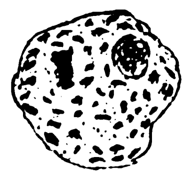
interprets as the preliminary stages in the schizogony. The second group comprises figs. 107 to 110, and deals with a much more complicated arrangement. Each figure is divisible into two portions, one portion containing a number of deeply staining nuclei, and the other portion containing a single feebly staining nucleus which Schaudinn says becomes more and more feebly staining, but which, in other respects at least, seems to be indistinguishable from the



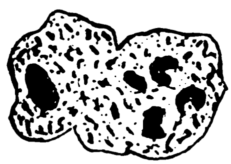
TEXT FIG. 2.—Being tracing of Schaudinn's fig. 104.



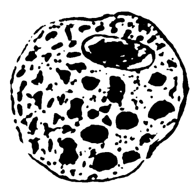
TEXT FIG. 3.—Being tracing of Schaudinn's fig. 105.



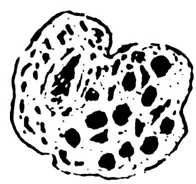
TEXT FIG. 4.—Being tracing of Schaudinn's fig. 106.



TEXT FIG. 5.—Being tracing of Schaudinn's fig. 107.



TEXT FIG. 6.—Being tracing of Schaudinn's fig. 108.



TEXT FIG. 7.—Being tracing of Schaudinn's fig. 109.

TEXT FIG. 8.—Being tracing of Schaudinn's fig. 110.

nucleus of an ordinary female gametocyte. All these figures were from preparations taken between 7 a.m. and 8.15 p.m. of the same day, from a single case within forty-eight hours of a febrile paroxysm. Presumably they are from preparations taken at different hours, and if any inference as to the feebly staining nucleus becoming more feebly staining is to be drawn, it should be

from comparing it with the nuclei of normal gametocytes on the same slide, and not from comparing the nuclear stain of a figure from one slide with that of one from another slide. Schaudinn does not seem to have controlled his findings in any way, as for example, to determine if the forms in group 1 have any relation whatever to the schizogonous cycle, and if those in group 2 are confined to cases of relapse *after long interval;* and as already pointed out, his interpretations of these forms takes no account of the series of cycles that had already taken place. As a consequence of this neglect, he has, I believe, entirely misinterpreted his figures, and has pieced together two quite independent phases of the parasite to form a scheme of development in support of his so-called parthenogenesis theory of relapses. With the aid of coloured drawings, 2 to 36 on Plate, I hope to show (*a*) that Schaudinn's figs. 107 to 110 are to be interpreted as representing combination forms, each consisting of an ordinary female gametocyte (full-grown or nearly so), and a schizont undergoing schizogony which had occupied the same red cell, and are so closely interlocked that they appear to be fused into one; and (*b*) that figs. 104 to 106 are mature female gametocytes, exhibiting early stages of, or preliminary steps towards, maturation that have taken place during the interval between the time that the blood was shed and the time that the film was fixed, or had dried on the slide. (*a*) Beginning with the forms included in group 2—figs. 2 to 30 show: (1) that though these forms are found at the beginning of relapses after long intervals, they are not confined to such cases; (2) that along with these forms we find other two combinations, so that all three possible combinations of gametocyte and schizont are found in the same film or in films of the same blood taken at the same time, viz., "gametocyte + schizont," "gametocyte + gametocyte," "schizont + schizont"; (3) that by appropriate staining many of these compound forms are clearly seen to be combinations, and (4) that (2) and (3) are borne out by comparison with ordinary single schizonts and gametocytes in the same films. Thus Case 1, figs. 2 to 6 are from a relapse after an interval of six and three-quarter months. All are from the same film taken during the first paroxysm of the relapse. On the day but one previous to this the patient had felt chilly, and his temperature had been up for a few hours. Figs. 2 and 3 represent what on the so-called parthenogenesis theory would in this case be interpreted as schizogony of macrogametes. The pale staining nucleus in each of the figures is not paler than the average nucleus of single female gametocytes in the

same film. Fig. 4 shows the combination "schizont + schizont," and fig. 5 the combination "gametocyte + gametocyte." Fig. 6 from the same film shows an ordinary schizont divided into merozoites. Case 2, figs. 7 to 12 are all from one blood-film taken during the first paroxysm of a relapse in a case that had been having constantly recurring relapses, each lasting four or five days, at intervals of two weeks or thereby. Figs. 7, 8 and 9 show the combination "gametocyte + schizont" in which the dividing line between schizont and gametocyte can be fairly clearly traced. Figs. 10, 11 and 12 show the combinations "gametocyte + gametocyte" which as was to be expected were more numerous than the combination "schizont + schizont" in this case. Case 3, figs. 13 to 26 are all from one case. The patient was admitted to hospital on the ninth day of a relapse. He had had eight paroxysms, one daily before admission. Figs. 16, 17 and 23 are from a film taken during the rigor of the ninth paroxysm of the relapse, i.e., the fifth paroxysm caused by the series of generations to which they belong. All the others (13 to 15, 18, 19, 20 to 22, 24 to 26) are from another film three and a half hours earlier, or about three hours before this rigor began, and belong to the same generation as the last. In this case, and in contrast to the last mentioned, the combinations "schizont + schizont" were more numerous than "gametocyte + gametocyte." Figs. 13 to 23 show the three possible combinations very clearly, and the dividing lines can be traced in diminishing degrees of distinctness until the two forms of each of these combinations appear to be almost fused into one. Figs. 24 to 26 show different stages in schizogony of ordinary schizonts in the film from which figs. 13 to 15, 18, 19, 20 to 22 were drawn. Case 4, figs. 27 to 30, are from a blood-film taken during the first paroxysm of a first attack of malaria fever eight and a half months after the patient had left a malarious district. He had been in Salonika and neighbourhood for about eight months, and in the Struma Valley for two weeks before he was wounded. Up to the time he was wounded he had taken quinine every afternoon, but had not taken any since then. He was in Malta for about three months after he was wounded, and in the King George Hospital for nearly five months before the paroxysm referred to, the first he ever had, developed. Figs. 27 and 28 show the same combination forms of "gametocyte + schizont" (the latter, of course, dividing). In fig. 27 the gametocyte is a male, and in fig. 28 it is a female; while, arranged immediately below these, figs. 29 and 30 represent an

ordinary male and an ordinary female gametocyte from the same film.

(*b*) Coming now to Group 1. It is a general rule that where vegetative and generative chromatin are combined in the same nucleus, the elimination of what is considered to be effete, or vegetative chromatin, is the first step towards maturation, and is a necessary preliminary to gamete formation. In the case we are considering this step naturally begins as soon as an efficient stimulus is given to the mature gametocyte when it leaves the vertebrate host. What constitutes an efficient stimulus is not definitely known, but it may be that a certain temperature and a certain amount of moisture, giving rise to a change in osmotic pressure, constitutes such a stimulus. Be this as it may, when once the stimulus is given to the mature gametocyte, the elimination is effected quickly, and the effete chromatin always stains more deeply than does the generative chromatin left in the nucleus. This is illustrated rather strikingly in the figures that illustrate "initial changes in the exogenous cycle of *P. falciparum*" dealt with in the next section of these notes. Figs. 31 to 36 show similar changes in the nucleus of gametocytes of *P. vivax*. All are from a slide prepared in the ordinary way with no conscious variation or arrangement of conditions different from those under which all the other slides dealing with this section were prepared. I have seen similar appearances in other slides, and they do not depend on the parasite being at any particular stage of its schizogonous cycle, but on there being mature gametocytes present in the blood when the films are made. The time in relation to the schizogonous cycle at which the film from which figs. 31 to 36 were drawn, excludes any chance of the nuclear change being the first stages in a schizogony. It was prepared at the height of a paroxysm from the same case and at the same time as the film from which figs. 7 to 12 were drawn. The separation of the dark staining effete or vegetative chromatin from the generative chromatin of the nucleus, and the earlier stages in its elimination, may be traced in figs. 31 to 33, while figs. 34 to 36 show it in the process of being thrown off. The "smaller stronger staining portion" in Schaudinn's figures included in Group 1 may in the same way be interpreted, without having resort to any unproved hypothesis, as effete or vegetative chromatin that is being eliminated in the normal way, and that this elimination began after the blood was shed and continued during the interval up to the time that the film was fixed, or had dried on the slide.

SUMMARY, AND CONCLUSIONS FROM THE FOREGOING EXAMINATION OF SCHAUDINN'S PARTHENOGENESIS VIEW OF RELAPSES.

(1) Schizogony of macrogametes as described by Schaudinn, even if it were established, cannot be regarded as evidence of the occurrence of parthenogenesis among protozoa. In the strict sense in which that term is used when dealing with metazoa, it could be applied in the case of *P. vivax* only if the female gamete without syngamy went through its exogenous cycle.

(2) Schaudinn's observations were not sufficiently controlled; and in interpreting his figures he seems to have taken no account of the incubation stage that precedes the febrile attack. All of his figures are from films taken within forty-eight hours before an actual paroxysm: and to expect to find the forms that initiate the series of schizogonous cycles that lead to a febrile relapse at that stage seems quite as unreasonable as to expect to find sporozoites on the twelfth day of the incubation stage of a first attack.

(3) The observations described in this paper show that compound forms such as Schaudinn figures are not confined to the particular class of case to which he assumed they were, that they are combinations of gametocyte and schizont, and further that the changes in the nucleus of gametocytes that he interprets as the earliest changes in his scheme of gameto-schizogony have no relation in time to the schizogonous cycle, but depend on the presence of mature gametocytes in the blood at the time the films are made.

(4) All his findings and figures can be explained and interpreted quite naturally in accordance with established facts without the necessity of resorting to unproved hypothesis.

(5) In building up a scheme in support of his so-called parthenogenesis theory to explain relapses, Schaudinn not only misinterpreted his figures, but he brought together two quite independent phases of the parasite.

Another view put forward to explain relapses assumes that schizogony goes on without intermission throughout the intervals between relapses. According to Minchin, "Ross believes that in the healthy intervals the number of parasites in the blood merely falls below that sufficient to produce febrile symptoms, and that a relapse is brought about simply by an increase in the number of parasites present." During the incubation period of an average first attack of malaria fever schizogony goes on regularly, and conditions being favourable only schizonts are produced, so that the

parasite tends to multiply by geometrical progression, and very soon the numbers in the blood increase enormously. With *P. vivax* the average length of a normal incubation period is said to be about fourteen days, so that, beginning with the sporozoites inoculated, no more than about six cycles normally take place before the parasites that will complete their schizogony two days later are sufficiently numerous to cause the characteristic febrile reaction in the host. Ross's view (or the view ascribed to him by Minchin) explains perfectly a large group of cases that relapse at intervals approximating to the ordinary incubation period, and others where the interval has obviously been prolonged by the continuance of special conditions such as the exhibition of quinine. Other conditions not so obvious may also tend to lengthen the interval between relapses, and the production of gametocytes at the expense of schizonts would have this effect. But there are relapses that occur *after long intervals* (several months to a year or more) of apparently perfect health on the part of the host; and, after making every allowance, it is difficult in the absence of direct evidence of the activity of the parasite, or of its presence in the blood, to accept this view of uninterrupted schizogony to explain these cases. It is most probable, and I think it must now be assumed, that relapses are made possible by the survival in some way of asexual (not sexual) forms, but the way in which they survive is another question. It seems also reasonable to suppose that as long as these asexual forms remain in the blood of their host they must go on multiplying or die out altogether. But it would not be contrary to what is known about protozoa in general, to suppose that the asexual forms that survive do so by finding their way out of the blood-stream when conditions become unfavourable to their existence there, and, adapting themselves to nutritive changes, enter a resting stage in their new environment. Speculations such as these can be useful only as working hypotheses. With better methods of blood examination the hypothesis that schizogony goes on without intermission throughout these long intervals of apparent health between relapses may be either proved or made more improbable. Meanwhile it seems more in accordance with present knowledge to assume that in these cases, and in cases of very long delayed first attacks, there is a resting state in which the asexual form of the parasite remains quiescent during the greater part of these intervals; that this stage is passed outside the blood-stream (possibly in endothelial cells of the spleen, bone-marrow, etc.); and that, re-entering the

blood-stream, the parasite becomes active again before the relapse for a time which corresponds roughly with the incubation period of first attacks, but which is liable to be considerably prolonged if the change from unfavourable to favourable conditions is gradual and prolonged, and so favours the production of a large proportionate number of gametocytes during the earlier schizogonous cycles. The occurrence of relapses in some treated cases where the relapse is due to multiple or to mixed infection seems to favour the idea of a protected quiescent stage of the parasite. In the case of mixed infections referred to above (p. 387), the parasite causing the relapse escaped the action of quinine in doses that it would not be expected to have withstood in the way it did if it had been in the blood-stream undergoing schizogony at the time that these doses were given.

(*b*) Initial stages in the sexual cycle of the parasite of malignant tertian—phases not previously figured or described (figs. 37 to 55, Plate).

The preparation from which figs. 39 to 43 and 46 to 55 were drawn was made under the following conditions: The most favourable temperature for the natural development of crescents in anopheles being from 28° C. to 30° C.—the slide on which the film was spread, and the moist chamber (a Petre dish with the bottom piece covered with moistened filter paper) in which it was placed (see below) were kept in an oven at 30° C. for some time before being used. From this they were carried to the ward wrapped in a towel at the same temperature. A moderately thick film of peripheral blood known to contain many crescents was spread on the slide without unnecessary delay, was breathed upon, and then placed in the moist chamber referred to. This was again wrapped in the towel and carried to the laboratory, and placed for a short time in the oven registering about 30° C. About ten minutes later the slide was taken from the moist chamber, and, while still wet, the film was exposed to the action of osmic acid vapour for fifteen seconds, in order to fix the parasites in the position in which they then were. The film was then allowed to dry, and as the last traces of visible moisture disappeared, methyl alcohol was poured over it, and was allowed to act for fifteen minutes. The excess of methyl alcohol was then shaken off, and the film was stained with Giemsa.

Figs. 37 and 38 represent typical male crescents, and figs. 44 and 45 female crescents from an ordinary blood-film prepared at the same time. Figs. 39 to 43 and 46 to 55 show the changes that took place in the preparation above described. From these figures

it would appear that the limiting membrane of the mature female crescent is more resistant than that of the male. In the female this membrane appears to be more of the nature of a cyst wall, and from this the female gamete (maturation having already taken place) seems to escape. The opening, or rupture, through which the gamete escapes, is in the great majority of cases (ninety-eight per cent) situated at or near the middle of the concave aspect of the crescent. In the straight sausage forms it is also about the middle of the long axis. In the male traces of the limiting membrane may still be seen, but it appears to give way fairly evenly all over, with the result that the male now assumes a more or less spherical form. Shreds of ruptured membrane are sometimes to be seen clinging to the surface. Before exflagellation takes place, however, the male maturates in the same way as the female by giving off nuclear matter in the form of "polar bodies"—usually two—(figs. 40, 41, and 43), but often appearing as a single mass (figs. 39 and 42). These polar bodies stain more intensely than the gamete-nucleus, and are very conspicuous in the stained preparation. In the case of the male they are seen lying on the surface of the sphere (figs. 40 to 43). In the case of the female they may be seen in different positions as one mass or as two separate bodies. Thus in fig. 46 they are seen as one mass at the pole of the capsule nearest to the nucleus; in fig. 47 at the pole farthest from the nucleus. In figs. 54 and 55 they are seen as one mass also near one of the ends of the capsule, but projecting from the surface. In fig. 51 a single wedge-shaped mass is seen outside on the surface of the capsule near its middle opposite to the escaping gamete. In fig. 53 two distinct bodies are seen protruding from one end of the capsule. In figs. 48 and 49 the polar bodies are seen applied to the side of the protruding part of the gamete; in figs. 50 and 52 they seem to have been pushed out in front of it—as two bodies in fig. 50—and as a single mass in fig. 52. Figs. 46 to 55 show the gradual escape (or extrusion) of the gamete—first a gradually increasing quantity of body protoplasm, with a stream of pigment granules, then the nucleus, and lastly the remainder of the body protoplasm and pigment granules, leaving behind an empty capsule, with, it may be, the polar body on the surface (fig. 55).

Whether the above truly represents the natural development and the true sequence of events, or whether it is an artificial product, can only be conclusively proved by examination of a series of anopheles at short intervals after they have fed on crescent-containing blood. It is not enough to say that no such forms have

ever been observed in living coverslip and slide preparations such as are used to demonstrate the process of "exflagellation" of male gametes, for in that case the same argument of unnatural conditions would apply perhaps even more forcibly. The possibility of these appearances having been produced by drying may, I think, be dismissed at once. The plump appearance of the parasites, the different behaviour of males as compared with females, and the fact that the whole of the film was quite moist when it was exposed to the vapour of osmic acid which would fix the parasites in the position and form in which they then were, are all against such a possibility. The best examples of both male and female forms here figured and described are found in what appears to be medium thin parts of the film, but this appearance of moderate thinness in different parts of the dried film is very probably, in part at least, due to the proportion of moisture to blood cells that existed at these parts of the moist film. Change in osmotic pressure may be a more probable explanation. Miss Muriel Robertson (1911) suggested that in the development of fish trypanosomes in the leech the stimulus that initiated the developmental changes was the lowering of the osmotic pressure of the blood and the probable absorption of water by the trypanosome consequent upon this. In the same way the lowering of osmotic pressure in the blood in the case we are considering (and the same thing may happen in "anopheles") would supply the initial stimulus to developmental changes in the crescents; while the consequent absorption of moisture by the crescents would raise their internal pressure and bring about the further changes here depicted. The male, with its thin limiting membrane which gives way fairly uniformly all over, tends to assume the spherical form. But given the crescent (or curved sausage) form, and an uniformly unyielding membrane, as in the case of the female crescent, increase of internal pressure tending to straighten out the crescent would tend also to rupture the membrane about the middle of its concave aspect, and any weakness of the membrane at this part would determine the point of rupture. In this way the large proportion (ninety-eight per cent) of female crescents in which the point of escape is about the middle of the concave aspect may be accounted for. Owing to its consistence the naked gamete, or as much of it as had escaped, would naturally assume the spherical form.

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EXPLANATION OF PLATE.

[It will be noticed that the references are to coloured drawings, but owing to the difficulties in reproduction it has been found necessary to reproduce the plate in black and white.]

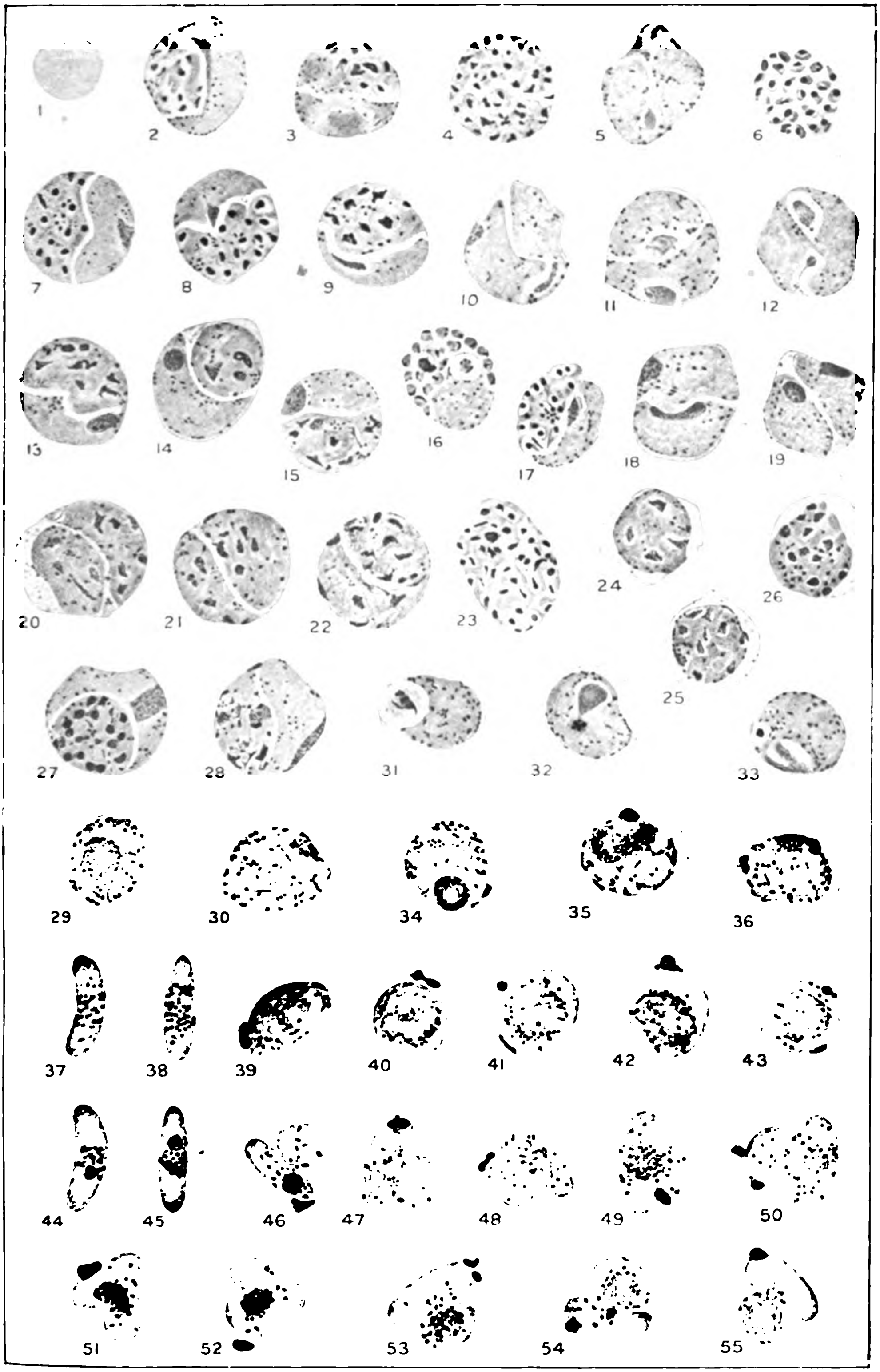
The magnification of all the figures is 1,500 times linear. All have been drawn and coloured by Miss Rhodes of the Lister Institute—camera lucida, an apochromatic 3 mm. oil immersion lens, and incandescent gas-light being used. All are from preparations stained by the Romanowsky method. Figs. 1 to 36 are from films dried and fixed in methyl alcohol: figs. 37 to 55 from films fixed while still moist in osmic acid vapour, and then in methyl alcohol.

FIG. 1.—Normal red cell.

FIGS. 2 to 6.—From a film of peripheral blood taken during the height of the first paroxysm of a relapse after six and three-quarter months. Figs. 2 and 3, which on Schaudinn's so-called parthenogenesis theory would be interpreted as schizogony of macrogametes, show the combination "gametocyte + schizont," the schizont undergoing schizogony. Fig. 4 shows the combination "schizont + schizont," both undergoing schizogony. Fig. 5 shows the combination "gametocyte + gametocyte." Fig. 6 shows merozoites resulting from the completed shizogony of a single schizont.

FIGS. 7 to 12.—From a film of peripheral blood taken during the height of the first paroxysm of a relapse, after constantly recurring relapses at short intervals (two to three weeks). Figs. 7, 8 and 9 show the combination "gametocyte + schizont," the schizont undergoing schizogony, where the dividing line between gametocyte and schizont is fairly clear. Figs. 10, 11 and 12 show the combination "gametocyte + gametocyte." The remains of the red cell can be seen in figs. 10 and 11.

FIGS. 13 to 26.—From films of peripheral blood taken on the ninth day of a relapse. The patient had had daily paroxysms for eight days preceding the day on which the films were taken. All the figures with the exception of figs. 16, 17 and 23 are from a film taken about three hours before the paroxysm began. Figs. 16, 17 and 23 are from a film taken during the "rigor" three and a half hours after the first film was taken. Figs. 13 to 17 show the combination "gametocyte + schizont." In figs. 13



To illustrate "Notes on Malaria," by JOHN D. THOMSON, A.M., M.B., C.M.

to 15 schizogony is fairly well advanced, in figs. 16 and 17 it is nearly completed. The dividing line between gametocyte and schizont is clearly seen in figs 13 and 14, but is much less distinct in figs. 15, 16 and 17. The remains of the red cell can be traced in fig. 14. Figs. 18 and 19 show the combination "gametocyte + gametocyte." The dividing line between the gametocyte and the remains of the red cell can be cleary seen in fig. 18, and are less distinct in fig. 19. Figs. 20 to 23 show the combination "schizont + schizont." Schizogony is fairly well advanced in figs. 20 to 22, and in fig. 23 it is nearly completed. The dividing line between the two schizonts and the remains of the red cell are fairly distinct in figs. 20 and 21. In figs. 22 and 23 no remains of red cell are to be seen, and there is no distinct line of division between the schizonts, but in fig. 22 schizogony has advanced slightly further in one schizont than the other. Figs. 24 to 26 show ordinary schizonts at different stages of schizogony with the remains of their red cells.

FIGS. 27 to 30.—From a film of peripheral blood taken during the height of the first paroxysm of a first attack of malaria fever eight and a half months after the patient had left a malarious district. Figs. 27 and 28 show the combination "gametocyte + schizont," the schizont undergoing schizogony. No remains of red cells are to be seen. In fig. 27 the gametocyte is a male. In fig. 28 the gametocyte is a female. Fig. 29 is an ordinary male gametocyte, and fig. 30 an ordinary female gametocyte, and in each case the remains of the red cell are easily seen.

FIGS. 31 to 36 show stages in the elimination of effete or vegetative chromatin from the nucleus of ripe gametocytes, which must have taken place during the interval between the time that the blood was shed and the time that the film dried on the slide. The remains of the red cells are clearly seen. Fig. 31 shows the separation of the deeply staining effete or vegetative chromatin from the pale staining generative chromatin in the nucleus. Figs. 32 and 33 show the smaller deeply staining mass separated from the nucleus, while figs. 34 to 36 show it on the surface of the parasite on being extruded.

FIGS. 37 and 38.—Male "crescents" from an ordinary blood-film fixed in osmic acid vapour.

FIGS. 39 to 43.—Maturation of male crescents. Fig. 39, early stage—body still elongated, "polar body" deeply staining at one end close to surface but still inside. In figs. 40 to 43 the parasites have become spherical, and the polar bodies are seen lying on or projecting from the surface. In fig. 40 the two polar bodies are distinct but joined together. In figs. 41 and 43 they are separate, and at some distance from each other. In fig. 42 they appear as one, or as one on top of the other. In all the nucleus is large and diffuse, and, though it stains readily, the polar bodies stain more deeply and are very conspicuous.

FIGS. 44 and 45.—Female "crescents" from the same film as figs. 37 and 38.

FIGS. 46 to 55.—Maturation of female crescents, from the same film as figs. 39 to 43. Here the limiting membrane retains its shape, and the gamete escapes from a rent or opening near the middle of the long axis, leaving behind or carrying with it the polar bodies. These bodies stain much more deeply than the nuclei, and are prominent features in the stained preparations. In fig. 47, a comparatively early stage, the polar bodies appear to be still within the capsule. In fig. 46 partly in and partly out. In all the others they are wholly outside. The gradual escape of the gamete from the limiting membrane, or capsule, can be traced from fig. 46 to fig. 55. In figs. 46 and 47 only part of the cytoplasm carrying a few of the pigment granules has escaped, and in each the nucleus is still some way from the opening. In figs. 48 to 50 the nuclei are nearer to the openings of escape. In fig. 51 the nucleus is half way out, still further out in fig. 52, fully out in figs. 53 and 54, although some cytoplasm and pigment granules still remain, and in fig. 55 the whole gamete has escaped, leaving behind an empty capsule, with in this case the polar body clinging to its surface.

STUDIES IN AGGLUTINATION.[1]

By Captain R. P. GARROW, M.D., D.P.H.
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I.—The Course of Agglutination in Healthy Individuals after Antityphoid Inoculation.

(1) The object of this study was to determine the course of agglutinin production in healthy persons, who had been inoculated against typhoid fever, but who had never suffered from typhoid or paratyphoid fevers. It was thought that such information might be helpful in the interpretation of agglutination results in cases of enterica occurring in T-inoculated patients. The technique employed was one already described for the clinical agglutinometer.

(2) The specimens of blood required for this study were obtained from the personnel at the Military Hospital, Malta, during the months of November, 1915, to January, 1916. I am much indebted to all those who so kindly enabled me to obtain the material required, and to the commanding officer, Major A. Elliot, R.A.M.C.(T.), for permitting me to carry out this work.

The numbers examined were:—

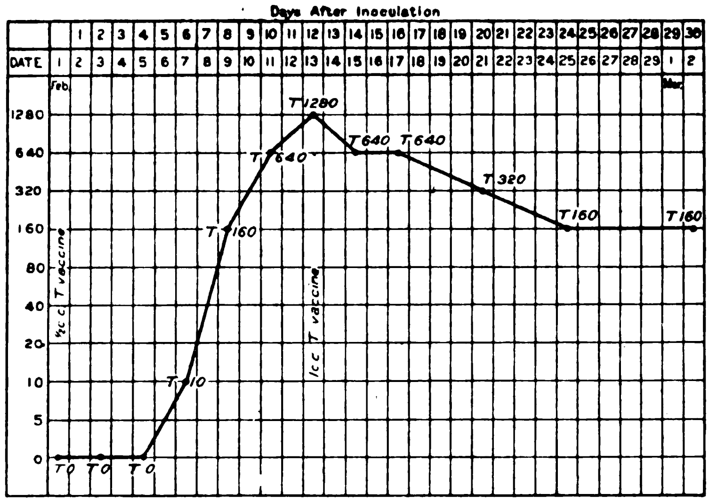
Officers	25
Nursing Staff	30
N.C.O's. and men	147
Others	2
Total ..	204

In each case the following particulars were noted: (*a*) The number and dates of inoculations. (*b*) The degree of reaction following inoculation.

In addition I examined twelve specimens of blood taken at intervals of a few days from an individual immediately following antityphoid inoculation, the results of which are represented in Chart I.

(3) The results obtained are analysed in Tables I, II and III, and represented in graphic form in Charts I and II. Chart II should be read as a continuation of Chart I. These two charts, read together, show clearly the five phases in the agglutinin response to antityphoid inoculation, viz.:—

[1] A Report to the Medical Research Committee.



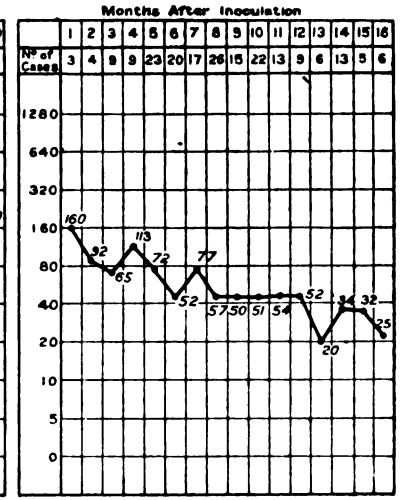


CHART I. CHART II.

CHART I.—Agglutinogram showing the T inoculation agglutinin titres obtained by repeated examinations of the blood of an individual for one month after T inoculation. The examinations were made by means of the clinical agglutinometer. No agglutinins for A or B were detected in dilution of 1 in 10 or upwards.

CHART II.—Composite agglutinogram indicating average titres at monthly intervals of 200 T-inoculated persons. The examinations were made by means of the clinical agglutinometer. No agglutinins for A or B were detected in 1 in 10 or upwards.

(*a*) A latent period of four or five days, during which time no agglutinin was detected in dilution of 1 in 10 or higher.

(*b*) A period of rapidly rising titre setting in about the fifth or sixth day, and lasting till the twelfth day.

(*c*) A maximum agglutinin titre reached on the twelfth day after inoculation.

(*d*) A period of rapidly falling titre lasting from the twelfth day till about the twenty-fourth day.

(*e*) *A period of residual agglutinin* commencing about the twenty-fourth day after inoculation, and lasting until the inoculation agglutinin finally disappears entirely from the blood.

The distinction between (*d*) and (*e*) may appear to be more or less arbitrary. It is, however, a convenient distinction. The period of residual agglutinin is reached when repeated examinations at intervals of a few days indicate that the agglutinin content of the blood is more or less constant. There is during this period a gradual slow fall in the agglutinin—but so gradual as to be hardly recognizable over a short period of say a few weeks. This phase is the most important one from the point of view of the diagnosis of enterica in inoculated individuals, and merits further attention.

(4) *The Period of Residual Agglutinin after Antityphoid Inoculation.*—The period of residual agglutinin may be conveniently regarded as commencing in the majority of T-inoculated individuals within a month after inoculation. Tables I and II and Chart II indicate the general behaviour of residual inoculation-agglutinin.

Of 204 persons examined a month or longer after inoculation, only four failed absolutely to show T agglutinin in titre of 1 in 10 or upwards. These four cases have been excluded from Chart II. The remaining 200 cases are arranged in monthly groups according to the number of months that had elapsed between inoculation and examination. The total period covered was the sixteen months from the outbreak of war till the completion of this study. By adding together the numbers representing the agglutinin titres of all the specimens in each monthly group, and dividing by the number of cases in the group a figure is obtained which represents *the average agglutinin titre of the blood for that period after the inoculation.* These averages are the figures plotted on the curve on Chart II which shows in a striking way the slow continuous fall which takes place in the T inoculation agglutinin over the period of sixteen months covered by the observations; and it is reasonable to assume that this fall continues until inoculation agglutinin disappears entirely from the blood. The irregularities on the curve are no

doubt due to the small numbers of cases in some of the monthly groups. In the first four and last four monthly groups, for example, the numbers of cases in each group are too small to furnish reliable averages—that is, averages which obliterate the great differences in individual specimens (the "personal factor"). From the fifth to the twelfth monthly groups inclusive, the numbers of cases are larger and give better averages—hence the comparatively smooth nature of the curve for that period. In spite of marked variations in agglutinin titre in different individuals from 1 in 10 to 1 in 160, the majority of the figures correspond closely to the average for the group they belong to. Thus 150 out of 200 specimens (that is 75 per cent) give titres immediately above or below the average for their group. The highest titre found amongst the 204 specimens examined was 1 in 160, but since this series was completed I have met with several cases of T-inoculated healthy individuals who gave a reading of 1 in 320. It is noteworthy that if, at some time previous to inoculation, the person had suffered from a T infection, the titre of his residual agglutinins may be much higher. I have examined two such cases:—

(1) Sister E. E. F. had typhoid fever seven years previously and antityphoid inoculation six months previously. Agglutinations T 640, A 0, B 0.

(2) Lieut. W. R. had typhoid fever twelve years previously. His blood failed to agglutinate T, A or B. He received ½ cubic centimetre of T vaccine on January 9, 1916 and 1 cubic centimetre on February 3, 1916, and gave the following results:—

TABLE I.

Date	T.	A.	B.
January 9	0	0	0
10	0	0	0
11	0	0	0
12	0	0	0
13	0	0	0
14	0	0	0
15	10	0	0
19	640	0	0
24	1,280	0	0
26	2,560	0	0
February 1	2,560	0	0
3	2,560	0	0
6	2,560	0	0
9	2,560	0	0
25	1,280	0	0
March 28	1,280	0	0
April 14	1,280	0	0

Residual agglutinin titre, 1 in 1,280, three months after inoculation.

No specimen of the series showed any agglutinins for A or B in dilution of 1 in 10 or upwards; but it may be interesting to mention that this routine examination of the bloods of the personnel at the hospital was the means of discovering two hitherto undiagnosed (ambulatory) cases of paratyphoid B fever among the Royal Army Medical Corps detachment.

On November 15, 1915, Pte. E. M. (anti-typhoid inoculation April, 1915) gave the result T 640, A 0, B 80. He was a nursing orderly in the enteric wards. On being questioned he gave a definite history of severe headaches, anorexia, malaise, diarrhœa for a day or two followed by constipation. This illness lasted from October 16 till October 28. He took his temperature several times during this period and always found it raised—on one occasion it was 102·6° F—though he continued at his work. The result of the blood examination indicates that this illness was paratyphoid B.

Similarly Pte. J. L. (antityphoid inoculation April, 1915), whose blood on January 19, 1916, gave a reading T 40, A 0, B 20, had a history of headache, abdominal pain and fever in September, 1915. The result of the blood examination on January 16, 1916, suggests that this illness was also paratyphoid B fever. On account of their history these two cases were, of course, excluded from the series.

(5) Influence of *number of inoculations* on the residual agglutinin titre of the blood.

Table II shows the positive cases arranged in three groups according to the number of inoculations they have received.

TABLE II.

Number of inoculations	Number of cases	Average agglutinin titre	Average time since inoculation
1	8	35	8 months.
2	177	60	8 ,,
3 or more	15	52	10 ,,

It will be seen from this table that the number of cases inoculated only once, and the number inoculated three or more times, are too small to furnish reliable data to compare with the averages of those inoculated twice; but these figures, so far as they go, indicate that two doses of vaccine produce a distinctly higher residual agglutinin titre than one dose.

A third dose, however, does not appear to produce any further increase in residual agglutinin titre.

(6) Influence of the *degree of reaction* after inoculation on the residual agglutinin titre of the blood.

Each of the 200 persons, whose blood was examined, was asked to indicate the degree of reaction, local and general, which followed inoculation. According to the reply the reactions were classified as "mild," "moderate" or "severe" (1°, 2°, 3°). As the local and general reactions did not appear to bear any constant relationship in the same person, it has been found necessary to compile a separate set of figures for each.

These are seen in the following table:—

TABLE III.

Local reaction	Number of cases	Average agglutinin titre	Average time in months after inoculation
Mild ..	159	60	8 months.
Moderate	26	75	8 ,,
Severe	15	43	9 ,,
General reaction			
None ..	46	60	7 to 8 months.
Mild ..	116	60	8 to 9 ,,
Moderate	25	70	7 to 8 ,,
Severe	13	52	9 months.

Table III shows that a moderate degree of reaction (local or general) produces a higher average residual agglutinin titre at eight months after inoculation than does a mild degree of reaction. A severe reaction, however, is followed by a lower average residual titre.

(7) *Agglutination Tests in Diagnosis.*—The results above indicated have an important bearing on the question of the value of agglutination tests in the diagnosis of enterica in inoculated individuals. Their bearing on this question may be discussed under two heads:—

The diagnosis of typhoid fever in T-inoculated individuals.

The diagnosis of paratyphoid fever in T-inoculated individuals.

(8) *Typhoid Fever in T-inoculated Patients.*—The first important fact from the point of view of the diagnosis of T infection in T-inoculated individuals, is that the highest titre found in 200 T-inoculated healthy individuals was 1 in 160. Since these cases were examined and written up, I have met with several cases of healthy T-inoculated individuals who gave a T-inoculation agglutinin, reading 1 dilution higher—that is, 1 in 320.

I have, therefore, taken 1 in 320 as the "maximum residual T-inoculation agglutinin titre." By that I mean that if a person has been T-inoculated, and a month has elapsed since inoculation, the T-inoculation agglutinin titre as found by the agglutinometer will, *as a general rule*, not exceed 1 in 320. It follows from this that in estimating T agglutinin in the diagnosis of T infection in

T-inoculated patients a single examination giving a reading on the agglutinometer of anything up to 1 in 320 has *no diagnostic significance.*

On the other hand a single reading which is definitely above the maximum residual T inoculation agglutinin titre—that is to say, a reading of 1 in 640 or higher—has some diagnostic significance. It is, in the absence of A and B agglutinins, a point in favour of T infection. But the diagnosis by agglutination of T infection in T inoculated patients should not rest on the result of one examination alone. It is necessary to ascertain the titre carefully at intervals of a few days in order to discover whether the titre is constant or is rising or falling. Chart II shows that in health there is slow progressive fall in the titre of residual agglutinin from 160 a month after inoculation to 25 at the end of sixteen months. This fall is so slow that examinations made at intervals of a few days for a period of several weeks in a healthy individual give practically the same reading.

If, instead of this steady titre, one finds a marked fluctuation in titre consisting of a rise to a maximum followed by a fall it is clear that the immunity apparatus is under stimulation. Whether the stimulus is a T infection is a question which requires careful consideration. Before one can reasonably make a definite diagnosis of typhoid fever on this sign alone, it is necessary to be able to state that other diseases cannot possibly produce a similar fluctuation. Unfortunately, other diseases do produce such a fluctuation—e.g., in paratyphoid B fever in T-inoculated patients the stimulating effect on the T agglutinin is, on the average, as great, if not greater, than the effect of typhoid fever. These cases are, however, easily diagnosed by the recognition of the specific B agglutinin, which appears with extreme regularity. Paratyphoid A fever produces a like effect on the T agglutinin, though not so constantly, nor to such a marked extent. Here again the true nature of the fever can be easily recognized in the *majority* of cases by the appearance at the same time of specific A agglutinin, but the agglutinogenic power of an A infection is notoriously feeble and it is necessary always to test in low dilutions. The A agglutinin *at its maximum* may not be higher than 1 in 10. In fact, there is reason to believe that paratyphoid A fever in a T-inoculated patient may run its whole course and fail to produce any A agglutinin, while the T agglutinin may show a typical immunity response.

Such a case would be diagnosed by agglutination as typhoid fever. How far other fevers, not belonging to this group, can

stimulate inoculation agglutinins is a question which requires a great deal of patient investigation. Until a large amount of control work of that kind is carefully worked out, agglutination as a means of diagnosis in inoculated patients cannot be said to rest on any sure foundations.

In the meantime the error will probably not be a great one if, in a T-inoculated patient suffering from an illness which presents the clinical features of enteric fever, a steady rise in the T agglutinin titre to a maximum about the end of the third week followed by a slow fall, in the absence of A and B agglutinins, be regarded as indicative of typhoid fever.

TABLE IV.

Agglutinin titres	Months after Inoculation																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total cases
1 in 320 ..	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1 in 160 ..	**3**	**2**	2	**5**	4	1	5	8	1	1	1	1	0	0	0	0	29
1 in 80 ..	0	**0**	**1**	**2**	**8**	**6**	**3**	**5**	**3**	**5**	**3**	**1**	0	2	0	0	39
1 in 40 ..	0	1	**4**	1	**8**	**8**	**6**	**13**	**7**	**12**	**7**	**5**	**1**	**5**	**3**	**2**	83
1 in 20 ..	0	0	1	1	2	3	1	3	2	4	1	1	**3**	**3**	**2**	**3**	30
1 in 10 ..	0	1	1	0	1	2	2	2	2	0	1	1	**2**	3	0	1	19
Total cases ..	3	4	9	9	23	20	17	26	15	22	13	9	6	13	5	6	200
Average titres	160	92	65	113	72	52	77	57	50	51	54	52	20	34	32	25	

In Table IV, the 200 cases are arranged into sixteen monthly groups, according to the time that elapsed between inoculation and examination. Each monthly group is divided into sub-groups according to the titres obtained.

The average titre for each monthly group is given. The figures in heavy type belong to the sub-groups immediately above and immediately below the average for that group. They represent seventy-five per cent of the total cases.

Paratyphoid Fever in T-inoculated Patients.—No specimen of blood showed the slightest power of agglutination for A or B in a titre of 1 in 10 or upwards—that is, T inoculation does not produce A or B agglutinins.

It follows, therefore, that the mere recognition of A or B agglutinins (usually in addition to T agglutinin) in the blood in a T inoculated patient has a distinct diagnostic significance. It means

that the patient is suffering, or has suffered from A or B fever respectively. If the patient presents the clinical signs of enterica one is justified in diagnosing paratyphoid A or paratyphoid B. A possible source of error is that A or B coagglutinins may be formed during a T infection in a T-inoculated individual.

The presence of both A and B agglutinins (in addition to the T inoculation agglutinin) suggests double infection either past or present though not necessarily synchronous.

These remarks apply to the results of a single examination of the blood. *In the majority of cases of paratyphoid fever in T-inoculated patients, a single agglutination test, indicating the presence of A or B agglutinins when interpreted along with the clinical facts of the case, is sufficient to furnish a reliable diagnosis.* Strictly quantitative estimations repeated at intervals are not absolutely necessary. These exact methods are necessary only in the diagnosis of infections against which the patient has been inoculated—T infections in T-inoculated patients, and all enterica cases in T.A.B. inoculated patients.

It is possible, however, by employing a strictly quantitative technique and repeating the estimations, to render the diagnosis more certain, and to discriminate in many cases, without reference to the clinical facts of the case, between a *past* and a *present* paratyphoid infection. In a *past* infection the A or B agglutinin titre is usually *steady*. In a *present* (active) infection, it will usually show a *marked fluctuation*; it is thus obvious that anti-typhoid inoculation hardly interferes with the value of agglutination tests in the diagnosis of the paratyphoid fevers. The phenomenon of specific A or B agglutinin formation proceeds as in a normal non-inoculated patient. The observer must not be misled by the fact that in the meanwhile the T inoculation agglutinin may also show a marked sympathetic fluctuation in titre.

II.—Paratyphoid Inoculation in Typhoid-inoculated Individuals.

This study comprises over 500 estimations of the agglutinin content of the blood of 100 individuals who had at some previous date been inoculated against typhoid fever (T vaccine), and who were undergoing inoculation against paratyphoid fever (A and B vaccine). In order to make it quite clear that the vaccine contained paratyphoid A and B bacilli only, and was *not* triple vaccine

(T.A.B.), a facsimile of the labels on the bottles is here reproduced :—

Royal Army Medical College.

Paratyphoid Vaccine[1]

1 c.c. *Contains Para A*...500 *Millions*
Para B...500 ,,

1st Dose for an Adult, ½ c.c. or 9 min.
2nd Dose ,, ,, 1 c.c. or 18 min.

The object of this study was to obtain information which might be of value in the interpretation of agglutination results in cases of supposed enterica occurring in patients who had been inoculated against all three diseases.

The 100 individuals examined may be divided into two gronps ;—

(*a*) Ten Royal Army Medical Corps officers, who very kindly permitted me to make frequent examinations of their bloods.

(*b*) Ninety Royal Army Medical Corps orderlies who kindly allowed blood examinations on four occasions.

The results are analysed in Tables I to XII, and represented in graphic form in Charts I, II, and III.

TABLE I.—Indicating the "T" Inoculation Agglutinin Titres at Various Stages after Paratyphoid Inoculation.

"T" Agglutinin titre	Days after paratyphoid inoculation: 0	10	25	50
0	1 case	1 case	1 case	1 case
10	9 cases	0 ,,	0 ,,	2 cases
20	17 ,,	4 cases	5 cases	7 ,,
40	42 ,,	3 ,,	7 ,,	31 ,,
80	19 ,,	16 ,,	16 ,,	27 ,,
160	12 ,,	38 ,,	40 ,,	24 ,,
320	0 case	17 ,,	20 ,,	3 ,,
640	0 ,,	17 ,,	8 ,,	0 case
1,280	0 ,,	2 ,,	0 case	0 ,,
Totals	100 cases	98 cases	97 cases	95 cases.

[1] This vaccine was first prepared at the R.A.M. College in July, 1915, and supplies were sent to M. E. F. in August, September and October of that year.

TABLE II.—Indicating the "A" Agglutinin Titres at Various Stages after Paratyphoid Inoculation.

"A" Agglutinin titre	Days after paratyphoid inoculation 0	10	25	50
0	100 cases	0 case	1 case	3 cases
10	0 case	2 cases	0 ,,	4 ,,
20	0 ,,	1 case	1 ,,	10 ,,
40	0 ,,	10 cases	8 cases	35 ,,
80	0 ,,	11 ,,	20 ,,	21 ,,
160	0 ,,	22 ,,	20 ,,	18 ,,
320	0 ,,	25 ,,	31 ,,	4 ,,
640	0 ,,	24 ,,	15 ,,	0 case
1,280	0 ,,	1 case	1 case	0 ,,
2,560	0 ,,	2 cases	0 ,,	0 ,,
Totals	100 cases	98 cases	97 cases	95 cases

TABLE III.—Indicating the "B" Agglutinin Titres at various Stages after Paratyphoid Inoculation.

"B" Agglutinin titres	Days after paratyphoid inoculation 0	10	25	50
0	100 cases	3 cases	1 case	2 cases
10	0 case	1 case	2 cases	4 ,,
20	0 ,,	3 cases	2 ,,	9 ,,
40	0 ,,	5 ,,	7 ,,	35 ,,
80	0 ,,	20 ,,	31 ,,	26 ,,
160	0 ,,	33 ,,	35 ,,	16 ,,
320	0 ,,	23 ,,	15 ,,	3 ,,
640	0 ,,	9 ,,	4 ,,	0 case
1,280	0 ,,	1 ,,	0 case	0 ,,
	100 cases	98 cases	97 cases	95 cases.

TABLE IV.—Indicating Average T.A.B. Agglutinin Titres of the Blood of 100 "T" Inoculated Individuals at various Intervals after Paratyphoid Inoculation. (See Chart III).

Average agglutinin titre	Days after paratyphoid inoculation 0	10	25	50	120
For "T"	55	300	200	90	65
For "A"	0	330	257	80	43
For "B"	0	220	160	77	44

Note.—The figures in the last column are averages obtained from the examination of twenty cases only.

It will be convenient to examine these results from the point of view of :—

(*a*) The formation of Specific A and B agglutinins.

(*b*) The influence of paratyphoid inoculation on the T inoculation agglutinin.

(*c*) The application of these observations to the problem of the diagnosis of enterica in T.A.B. inoculated patients.

(a) The Formation of Specific A and B Agglutinins.

This process passes through the same five phases which I have already indicated for T-agglutinin-production following antityphoid inoculation, viz. :—

(1) A latent period.
(2) A period of rising titre.
(3) A maximum agglutinin titre.
(4) A period of falling titre.
(5) A period of residual agglutinin.

(1) *The Latent Period.*—The latent period is that which elapses from the day of inoculation till agglutinin appears in the blood.

TABLE V.

Number of case		Length of Latent Phase: A agglutinin		Length of Latent Phase: B agglutinin
1	..	8·0 days	..	6·0 days
2	..	10·0 ,,	..	—
3	..	4·5 ,,	..	7·5 days
4	..	4·5 ,,	..	2·0 ,,
5	..	8·0 ,,	..	8·0 ,,
6	..	6·0 ,,	..	6·0 ,,
7	..	8·0 ,,	..	8·0 ,,
8	..	5·5 ,,	..	5·5 ,,
9	..	2·0 ,,	..	5·5 ,,
10	..	3·5 ,,	..	6·0 ,,
	Average	6·0 days	..	6·0 days

Table V shows the duration of the latent period in ten cases. The average is six days for both A and B agglutinin.

(2) *The Period of Rising Titre.*—This phase lasts from the day on which agglutinin is detected in the serum till the agglutinin titre reaches its maximum, that is, from about the seventh till the twelfth or fourteenth day after inoculation. The relatively steep rise of the agglutinin curve in this phase will be noticed in Charts I, II, and III.

(3) *The Maximum Agglutinin Titre.*—The Table VI shows the period after inoculation at which the maximum occurred in ten cases.

The maximum titre was reached on an average on the thirteenth day for A agglutinin, and on the twelfth day for B agglutinin. It follows from this that the tenth day reading in the ninety cases of Table I does not represent the "maximum" in the majority of these cases. The actual maximum, occurring two or three days later, will naturally be higher than the recorded figures, but, taking

the maxima in the ten cases, along with the tenth day readings in the ninety cases of Table II, we get an average figure of 330 for A agglutinin, and 220 for B agglutinin.

TABLE VI.

Number of case		A maximum		B maximum
1	..	13th day	..	13th day
2	..	13th ,,	..	..
3	..	14th ,,	..	18th day
4	..	14th ,,	..	20th ,,
5	..	15th ,,	..	13th ,,
6	..	18th ,,	..	20th ,,
7	..	13th ,,	..	13th ,,
8	..	9th ,,	..	10th ,,
9	..	18th ,,	..	5th ,,
10	..	7th ,,	..	10th ,,
Average		13th day	..	12th day average

(4) *The Period of Falling Titre.* — This phase commences immediately after the maximum is reached and lasts till the agglutinin content of the blood is constant. This period is very variable, and in some cases the fall in titre of A and B agglutinins continues till these disappear entirely from the blood, in which case there is no residual agglutinin.

(5) *The Period of Residual Agglutinin.*—As already stated, there may be no residual agglutinin for A and B in some cases. The periods of falling titre continues till these substances disappear entirely from the blood. But in other cases they are more persistent, although, on an average, they do not remain as long as the T agglutinin following antityphoid inoculation. Ninety-five individuals examined fifty days after first inoculation with A and B vaccine showed the following titres (Table VII).

TABLE VII.

		Number of Cases		
Titres		A agglutinin		B agglutinin
0	..	3 cases	..	2 cases
10	..	4 ,,	..	4 ,,
20	..	10 ,,	..	9 ,,
40	..	35 ,,	..	35 ,,
80	..	21 ,,	..	26 ,,
160	..	18 ,,	..	16 ,,
320	..	4 ,,	..	3 ,,
		95 cases	..	95 cases

Twenty other individuals (not belonging to the group of 100 persons who furnished the material for this study) examined four

months after paratyphoid inoculation gave the following results. These individuals had all at some time previously been inoculated against typhoid fever :—

TABLE VIII.

	Number of Cases		
Titre	T agglutinin	A agglutinin	B agglutinin
0	1	0	0
10	1	4	1
20	3	5	8
40	7	8	8
80	4	1	1
160	4	2	2

The figures in the last column of Table IV are averages obtained from this table.

(B) *The Influence of Paratyphoid Inoculation on the T. Inoculation Agglutinin.*

The most striking feature in these results is the influence of an injection of mixed paratyphoid A and B vaccine on the residual T agglutinin derived from a previous antityphoid inoculation.

The influence may be *nil*—that is to say, the T agglutinin may remain undisturbed. Chart I is an example. But this is quite exceptional. The usual influence is stimulation of the T agglutinin forming mechanism, resulting in a further increased production of T agglutinin. The increase may be slight or it may be great. In Table IX the 100 persons who supplied the material for this study are arranged to show the extent to which the T inoculation agglutinin titre was increased in ten days, as a result of ½ cubic centimetre of A, B vaccine.

TABLE IX.—To show the Increase of T Agglutinin in the Blood of T-Inoculated Persons caused by Inoculation with a Paratyphoid A and B Vaccine.

Effect on T agglutinin titre	Number of cases	
Fall of 1 dilution or more	0	35 per cent of cases
No change in titre	14	
Rise of 1 dilution (100 per cent)	20	
,, 2 ,, (300 ,,)	28	65 per cent of cases
,, 3 ,, (700 ,,)	20	
,, 4 ,, (1,500 ,,)	10	
,, 5 ,, (3,100 ,,)	2	
,, 6 ,, (6,300 ,,)	4	
	98	

Table IX shows that the T agglutinin titre was undisturbed in 15 per cent of cases, and raised from 100 per cent to 6,300 per cent in the remaining 85 per cent; 65 per cent showed a definite rise of 300 per cent to 6,500 per cent of T agglutinin.

Fourteen cases showed no change and twenty cases a rise of only one dilution (100 per cent of agglutinin). A rise of one dilution might possibly be due to technical error—but if it were due to that alone one would expect some cases to show a fall of one dilution, which however was not observed in a single instance. It is therefore highly probable that there was a slight rise in the T agglutinin content of the blood in most of these twenty cases.

Let us, however, ignore this one dilution rise in twenty cases, and state that :—

"*Of* 98 *T inoculated individuals examined on the day of paratyphoid A and B inoculation* (250 *millions of each*) *and again ten days later,* 34 *showed no marked change in the T inoculation agglutinin content of the blood, while* 64 *showed an increase varying from* 300 *per cent to* 6,300 *per cent.*"

The increase of T agglutinin produced by paratyphoid inoculation will be found to pass through the same five phases as the A and B agglutinins : (1) a latent phase, (2) a period of rising titre, (3) a maximum titre, (4) a period of falling titre, (5) a period of residual agglutinin.

These five phases are clearly demonstrated in Chart II and will be seen to be practically synchronous with the corresponding phases of A and B agglutinin production.

This phenomenon of the rise and subsequent fall of T agglutinin resulting from paratyphoid A and B inoculation in T inoculated individuals raises several interesting questions :—

(1) What is the nature of the extra T agglutinin formed?

(2) What influences determine the T agglutinin increase and its extent?

(3) How long does the extra T agglutinin persist in the blood serum?

(4) Does the re-stimulation of the T agglutinin forming mechanism produced by paratyphoid A and B inoculation mean (in addition to immunity conferred against paratyphoid fevers) *a renewed immunity against typhoid fever ?*

(1) *The Nature of the Extra T Agglutinin.*—In Case 5 (Chart II) the T agglutinin rose from 10 on the day of first paratyphoid inoculation to 320 on the thirteenth day after—the A titre being 40 and B titre 320. On the thirteenth day the serum was saturated with paratyphoid A and B bacilli, after which it gave the following result—T 320, A 0, B 0.

The agglutination in dilution 1 in 320 for T was not so well marked as before removal of the A and B agglutinins, but the result

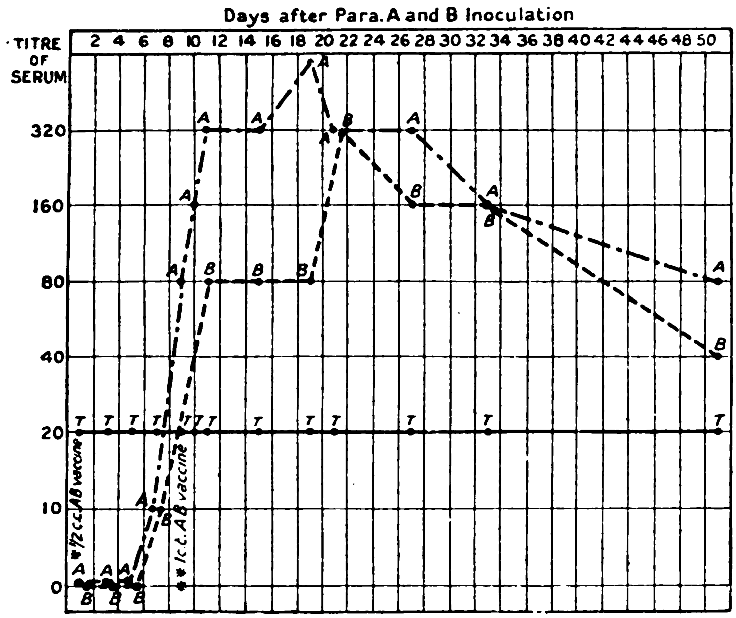


Chart I (Case 6).—Paratyphoid A and B inoculation in a person previously inoculated against typhoid fever.

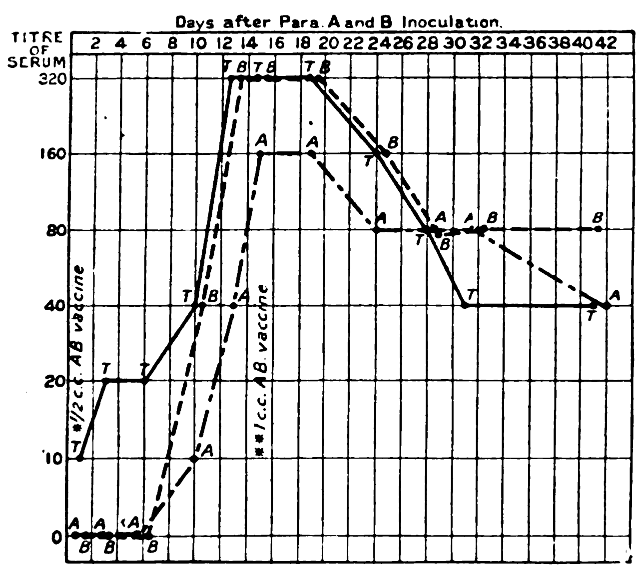


Chart II (Case 5).—Paratyphoid A and B inoculation in a person previously inoculated against typhoid fever. (Note the marked fluctuation of the T agglutinin.)

indicates that the additional T agglutinin produced in the serum of T-inoculated individual by paratyphoid A and B inoculation is *specific agglutinin.* It is not "coagglutinin" in the commonly accepted sense of the term. That is to say it is not absorbed from the serum to any extent by saturation with paratyphoid A and B bacilli.

Paratyphoid A and B inoculation in a person who has not been previously inoculated against typhoid does not produce any T agglutinin.

(2) *Influences which determine the Agglutinin Increase and its Extent.*—I have analysed the figures to find whether the extent to which the T agglutinin is increased is in any way dependent upon the amount of A and B agglutinin formed, but no obvious relation of the kind can be demonstrated.

TABLE X.—ANALYSIS OF T AGGLUTININ INCREASE IN RELATION TO THE A AGGLUTININ (10TH DAY).

Number of cases	A titre on the 10th day	Average T titre on 1st day	Average T titre on 10th day	Average T increase	Average T increase stated as a percentage
2	10	30	50	20	66 per cent
1	20	40	80	40	100 ,,
10	40	41	326	285	700 ,,
11	80	80	227	147	180 ,,
22	160	55	324	269	490 ,,
25	320	50	232	182	360 ,,
24	640	52	286	234	450 ,,
1	1,280	160	320	160	100 ,,
2	2,560	160	160	0	0 ,,

TABLE XI.—ANALYSIS OF THE T AGGLUTININ INCREASE IN RELATION TO THE B AGGLUTININ (10TH DAY).

Number of cases	B titre on the 10th day	Average T titre on 1st day	Average T titre on 10th day	Average T increase	Average T increase stated as percentage
3	0	70	140	70	100 per cent
1	10	80	160	80	100 ,,
3	20	80	270	190	240 ,,
5	40	60	144	88	150 ,,
20	80	48	166	118	250 ,,
33	160	61	286	225	370 ,,
23	320	44	338	284	650 ,,
9	640	71	409	338	476 ,,
1	1,280	80	160	80	100 ,,

It would appear from these two tables (X and XI) that the increase of T agglutinin in the blood of a T Inoculated person caused by A, B, stimulation does not bear any constant relation to the amount of A and B agglutinin formed.

In Table XII the figures are arranged to show what relation, if any, exists between the amount of T agglutinin present in the blood at the time of A, B, inoculation, and the T agglutinin increase resulting therefrom.

TABLE XII.—Analysis of T Agglutinin Increase in Relation to Original T Agglutinin Titre.

Number of cases	T titre on day of inoculation	Average T titre on 10th day	Average increase in T titre	Average increase stated as a percentage of original T agglutinin
9	10	220	210	2,100 per cent
17	20	330	310	1,550 ,,
41	40	218	178	445 ,,
18	80	302	222	277 ,,
13	160	345	185	115 ,,
98				

From the above table it will be seen that there is no definite relation between the amount of T agglutinin originally present and the extent of the increase (unless the latter is stated as a percentage of the former, in which case there is a marked inverse relationship).

(3) *The Duration of the Extra T Agglutinin.*—An interesting question is how long the extra T agglutinin produced by paratyphoid A and B inoculation in a T inoculated individual persists in the blood serum.

I have analysed the figures from this point of view, comparing the T titres on the fiftieth day after paratyphoid A and B inoculation, with those obtained on the day of first paratyphoid A and B inoculation.

As a result it was found to be :—

1 dilution lower in 6 cases	}	.. 80 per cent
In statu quo ante in 40 ,,		
1 dilution higher in 31 ,,		
2 dilutions higher in 15 ,,	}	.. 20 ,,
3 dilutions higher in 3 ,,		
95 ,,		

That is to say, in about one half of all the cases the T agglutinin had settled down to its original titre or below it, while in the remaining half the titre was one to three dilutions (i.e., 100 per cent to 700 per cent) higher. In 20 per cent of all the cases the T agglutinin was 200 to 700 per cent higher than previous to inoculation.

Omitting the 34 cases in which the T agglutinin showed no marked fluctuation, and confining this analysis to the 64 cases in which there was a T rise of 300 per cent or more, I find that 66 per

cent of these showed a titre on the fiftieth day 100 per cent to 700 per cent higher than the titre on the first day. In 25 per cent of the 64 cases the titre was 300 per cent to 700 per cent above the original T titre. Conclusion: The extra T agglutinin disappears relatively slowly.

(4) *The fourth question is one which has important practical bearings.* It would, for example, be a distinct advantage if the immunity to typhoid fever conferred by T vaccine could be renewed at appropriate intervals by an injection of paratyphoid bacilli, which is much less disturbing to the individual than a repetition of the T vaccine or triple (T.A.B.) inoculation. This question is, however, one which is beyond the scope of this paper.

The salient facts, then, with regard to this striking phenomenon of the rise of typhoid inoculation agglutinin in response to the stimulus afforded by paratyphoid inoculation appear to be:—

(1) Thirty-five per cent of persons show little or no fluctuation of the T inoculation agglutinin titre (Chart I).

(2) Sixty-five per cent of persons show a fluctuation of the T inoculation agglutinin titre varying from 300 per cent to 6,300 per cent (Chart II).

(3) The T agglutinin curve runs parallel with the curves of paratyphoid agglutinin, all their phases being practically synchronous (Chart II).

(4) The effect does not depend on the strain of paratyphoid bacilli injected, as this remained the same throughout.

(5) It does not bear any definite relationship to the original T inoculation residual agglutinin content of the serum.

(6) It does not bear any constant ratio to the amount of paratyphoid A and B agglutinins formed.

(7) The increased T agglutinins is not "coagglutinin." It is specific agglutinin.

(8) The extra T agglutinin disappears relatively slowly.

(9) The only explanation, then, for these differences in the nature and degree of the response appears to be "the idiosyncrasy of the individual."

These facts have an interesting parallel in the behaviour of the T inoculation residual agglutinin during paratyphoid A and B fevers. In both these diseases the T agglutinin may remain undisturbed, but in the majority of cases a fluctuation is noted. This fluctuation is most constant and most marked in paratyphoid B fever, and its phases are usually more or less synchronous with the phases of the paratyphoid agglutinin curve.

(C) *The Application of these Observations to the Problem of the Diagnosis of Enterica in T.A.B.-inoculated Patients.*

It will be seen from this and a previous study, that practically every person who becomes inoculated against typhoid and paratyphoid A and B fevers develops in his blood agglutinins for these bacilli, which are indistinguishable from those produced by the actual diseases.

The course of agglutinin production following inoculation has been worked out in a number of healthy individuals, and attention has been drawn to what may be called the "residual agglutinins."

The maximum residual titre of inoculation agglutinins as found by the agglutinometer is 1 in 320 for T.A.B.

Therefore one examination of the blood of a T.A.B.-inoculated patient giving a reading up to 1 in 320 has no diagnostic significance; but a titre of 1 in 640 or higher is suggestive of active enterica,

It is, however, always advisable to repeat the estimations at intervals of a few days throughout the course of the fever to ascertain whether the titres for T, A and B are remaining more or less constant or rising or falling. In a case of enterica in a triple inoculated individual the typical behaviour of the agglutinins is to show a steady rise to a maximum about the end of the third week of the illness, followed by a slow fall during convalescence.

This rise, however, does not usually influence the homologous agglutinins alone, but may affect two or all three agglutinins. That is to say the agglutinin response has lost its specificity, and it is impossible *in some cases* to differentiate the enteric diseases from one another by agglutination tests in triple-inoculated patients.

Further it is not yet known to what extent fevers and other diseases not in any way related to the enteric group may disturb the inoculation agglutinins. Until a large amount of control work of this kind has been patiently worked out, it is of course impossible to say definitely what diagnostic significance attaches to an agglutinin fluctuation.

Note.—These studies were carried out at the Military Infectious Hospital, Imtarfa, Malta, when Major A. Elliot, R.A.M.C.(T.) was O.C. To him, and to all the other officers, N.C.O.'s and men who so very willingly supplied me with the necessary material for investigation, I wish to take this opportunity of expressing my most sincere thanks.

Further reports relating to the behaviour of the agglutinins during active enterica in T-inoculated and triple-inoculated patients are in course of preparation.

The Position of Agglutination in the Diagnosis of Enterica in Inoculated Individuals.

(1) It has been well known for many years that the appearance of specific agglutinins in the blood is an almost constant feature of typhoid and paratyphoid fevers; and the agglutination test, when carried out in civil practice in uninoculated patients, with due precautions against certain possible sources of error, leads to a correct diagnosis in the majority of cases. The margin of error has been calculated to be less than three per cent.

But, in military practice, we have to deal with a population at least ninety per cent of which has been inoculated against one or all of the group of diseases included under the name "enterica" (typhoid fever, paratyphoid fever A, paratyphoid fever B).

Inoculation produces, in the blood of the inoculated individuals, agglutinins indistinguishable qualitatively from agglutinins produced by infection. It therefore follows that the mere qualitative recognition of agglutinins ceases to have the same diagnostic significance in the case of an inoculated soldier that it had in the case of an uninoculated civilian.

The recognition of this simple fact has divided the ranks of military medicine into two camps.

Camp No. 1 contains those who believe that agglutination tests furnish little or no reliable information in the diagnosis of enterica in inoculated individuals. This camp contains many well informed clinicians and some bacteriologists of repute; and they hold views indicating a fairly wide range in their estimate of the degree of futility of agglutination tests in the diagnosis of enterica in inoculated individuals.

Camp No. 2 contains those who believe that, with or without a modification of technique, it is still possible by agglutination tests to obtain information which is useful in the diagnosis of enterica in inoculated individuals. This camp is divided by much more acute differences of opinion than Camp No. 1. There is, within its ranks, at least one worker whose results lead him to the conclusion that the mere qualitative recognition of T agglutinin in the blood is of the same diagnostic value in a T inoculated, as in an uninoculated, febrile individual. Another member believes that, by using a

strictly quantitative method and repeating the test at suitable intervals throughout the disease, agglutination tests will furnish a uniformly accurate diagnosis.

(2) It is as a member of Camp No. 2 that I wish to express my views on this subject. These views are based on over 2,000 quantitative estimations of the agglutinin content of the bloods of inoculated individuals :—

(*a*) In perfect health.

(*b*) Suffering from enterica.

(*c*) Suffering from diseases other than enterica, in the Mediterranean War area from July, 1915, up to the present time.

My studies on this subject were carried on from July, 1915, till June, 1916, at the Military Infectious Hospital, Malta. The source of the enterica there was chiefly Gallipoli. A few came from Mudros, Salonica, and Malta.

From July, 1916, up to the present time, these studies have been continued at the Military Infectious Hospital, Cairo. The patients came chiefly from the "canal zone" of Egypt. Both at Imtarfa and at Choubra I was in charge of wards for enterica and dysentery, and so had the additional opportunity of studying the clinical aspects of the question. Owing to the kindness of my clinical colleagues at both hospitals, I was able to investigate a number of interesting cases which were not under my immediate care, and I wish to express my indebtedness to them for the material so obtained. The bacteriological control work was carried out in Malta by Captain N. Campbell, working in the laboratory there, and at Cairo by Captain P. H. Bahr, and later Captain L. T. Burra. In a certain number of the Cairo cases, in which positive bacteriological results were obtained, the bacteriological investigation had been carried out in the canal zone before the cases were transferred to Cairo, chiefly by Captains A. H. Priestley, W. H. Whitehead, and J. H. Horne. To all these bacteriologists, I wish to express my sincere thanks for their results.

I am much indebted to my commanding officers—Major A. Elliot, R.A.M.C. (T.), and later Temporary Lieutenant-Colonel G. B. Price, R.A.M.C., at Malta, and Major G. Hall, C.M.G., R.A.M.C. (T.), at Cairo, for permission to pursue these serological studies at a time when my duties were chiefly clinical.

(3) Before proceeding to the publication of these data in detail, there are certain general considerations which it is necessary to discuss, and on which it is necessary to have perfectly clear ideas.

The first consideration is the necessity for a "strictly quantitative technique"—that is, one which will ensure a reason-

ably accurate estimate of the relative agglutinin content of the blood.

The second consideration is the necessity for an intelligent interpretation of results obtained, in conjunction with the clinical pictures.

(4) *The Necessity for a Strictly Quantitative Technique.*—By a strictly quantitative technique is meant a process by which one can determine, not merely the presence of agglutinins in the blood, but also the relative amount of these agglutinins—that is the *agglutinin content* of the blood.

The usual, and, so far as I know, the best method of determining, and stating the relative amount of agglutinin in the blood is in the term of "titre," and by *titre* is meant *the highest dilution to which the serum may be titrated and continue to show the phenomenon of agglutination within a given time-limit.* A dilution scale which meets all practical requirements is the geometrical progression 10, 20, 40, 80, 160, etc.

It may be well to mention here that, owing to a difficulty which sometimes arises in reading the "end-point" of agglutination, exquisite accuracy in the chemical sense is not attainable in the routine estimation of the agglutinin-titre of blood. Even if such accuracy were attainable, it is not indispensable to the practical application of this method to the diagnosis of enterica in inoculated individuals.

Any technique in which the margin of error is not greater than *one dilution* in the scale which I have indicated above is sufficiently accurate for practical purposes and may therefore be regarded as a *strictly quantitative technique.*

The necessity for such a process of determining the agglutinin titre of the blood will be made clear by first indicating what occurs when a person is inoculated with a vaccine. If a person is injected with a suitable dose of a vaccine containing one or more of the enteric antigens T, A and B, and his blood is examined daily or at intervals of a few days for, say, one month by a *strictly quantitative agglutination technique*, it will generally be found that he produces specific agglutinins for each antigen injected. It will further be found that this phenomenon of agglutinin production passes through five distinct phases.

(*a*) A *latent period* lasting usually five to seven days (shorter or longer in some cases) from the day of inoculation. During this phase no agglutinin is recognizable in the blood serum.

(*b*) A *period of rapidly rising titre.* In this phase the agglutinin appears, say, on the sixth day after the inoculation, and increases

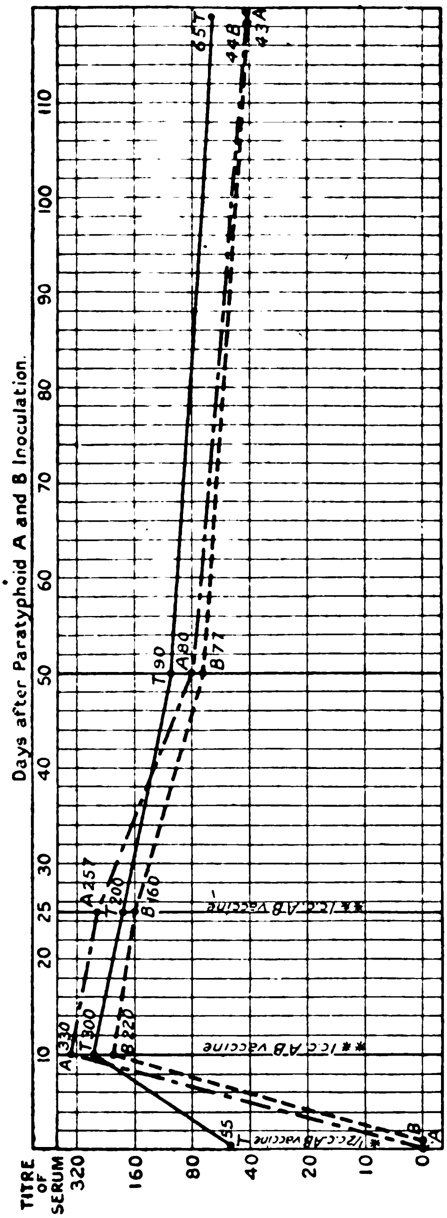


CHART III.—Shows the average course of agglutination after paratyphoid A and B inoculation in 100 persons who were previously inoculated against typhoid fever. (See Table VI.)

rapidly in amount, so that at each successive examination a higher agglutinin titre is reached.

(*c*) A *point of maximum agglutinin titre.* The rising titre continues till a maximum is reached, usually about the tenth to fourteenth day.

(*d*) A *period of rapidly falling titre.* The maximum agglutinin titre is followed by a rapid fall in titre. This fall becomes gradually less till a point is reached when repeated examinations at intervals of a few days indicate that the agglutinin titre is constant or nearly so.

(*e*) A *period of residual agglutinin.* When repeated examinations at intervals of a few days indicate that the agglutinin titre is remaining more or less constant, the individual has reached the *period of residual agglutinin.* This period may conveniently (if arbitrarily), be regarded as having been reached by the majority of inoculated individuals one month after the date of inoculation. This period may last for months or years, during which time there is a *slow* fall in the residual agglutinin titre, until the agglutinin disappears entirely from the blood.

(5) Although the objection may be raised that the distinction between (*d*) and (*e*) is an arbitrary one, it is none the less useful because, from the point of view of agglutination in the diagnosis of enterica in inoculated individuals, this period of *residual agglutinin* remains the most important one.

Should a triple-inoculated individual, having residual T, A and B inoculation agglutinin in his blood, become, in spite of this prophylaxis, infected with one of these bacilli, one would expect the more or less constant titre of his residual agglutinins to be disturbed, and the homologous agglutinin (that is the agglutinin corresponding to the infecting bacillus) to show an immunity response by a fluctuation in its titre. This response one would expect to pass through the same phases as those above described for the immunity response following inoculation, viz., (*a*) a latent period, (*b*) a period of rising titre, (*c*) a maximum agglutinin titre, (*d*) a period of falling titre, (*e*) a period of residual agglutinin. That is precisely what happens in the majority of cases of enterica in inoculated individuals, and it is just this fluctuation in titre which, when demonstrated by repeated examinations by means of a strictly quantitative technique, furnishes extremely useful information in the diagnosis of such cases.

(6) *But*—and this is a point of the greatest importance—it is found in cases of a single infection with T, or A, or B (proved by blood culture in T.A.B.-inoculated patients), that the response is not confined to the homologous agglutinin, *but may also affect, in*

a minor or in a marked degree, one or both of the heterologous agglutinins. That is to say, the immunity response to a single infection in a triple inoculated individual has to some extent lost that wonderful specificity on which T, or A, or B infections were formerly diagnosed in uninoculated patients by the agglutinin reaction. And the confusion does not end here, for there is reason to believe that a wholly heterologous antigen (i.e., an antigen having no relation to the enteric group), whether introduced artificially in the form of a dead vaccine or naturally as in disease, may cause a fluctuation of the residual inoculation agglutinins in a T.A.B.-inoculated individual. Further, a T.A.B.-inoculated individual may suffer from an illness presenting clinically a complete and typical picture of enterica, yet careful quantitative estimations of the T.A.B. agglutinins, repeated at intervals of a few days throughout the entire course of the illness and convalescence, may show *no fluctuations in these agglutinins.*

These disturbing facts do not mean that agglutination tests are of *no* value in the diagnosis of enterica in triple-inoculated individuals. But they lead naturally to the second general consideration which it is necessary to discuss, and to keep constantly in mind, namely :—

(7) *The Necessity for an Intelligent Interpretation of Agglutination Results in Conjunction with the Clinical Facts.*—Anyone who has followed the above argument will have no difficulty in appreciating this necessity. It is the crux of the controversy. Failure to recognize it has led, in some quarters, to the extravagant claim that agglutination tests alone will furnish a correct diagnosis in every case. The problem is, unfortunately, not the delightfully simple one which such a claim would suggest.

Intelligent interpretation implies an extensive knowledge of :—

(*a*) The behaviour of agglutinins during and after inoculation, and the possible fluctuations in titre of the residual T.A.B. agglutinins in healthy individuals.

(*b*) The influence of febrile conditions other than enterica on the residual T.A.B. agglutinins, and

(*c*) The fluctuations in titre of residual T.A.B. inoculation agglutinins in cases of enterica. The most valuable cases of enterica are, of course, those in which the diagnosis has been rendered *absolute* by successful blood culture. Every case of enterica, in which the infecting organism has been recovered from the blood, should have strictly quantitative estimations of the agglutinin content of the blood performed at intervals of a few days throughout the entire course of the illness.

It is only by having, for comparison, a large body of culture-controlled agglutination results that one can hope to interpret difficult agglutination results in cases in which culture has failed te give a diagnosis. By difficult agglutination results I mean results in cases showing marked fluctuation of two or even all three agglutinins.

During the last eighteen months, I have obtained a certain number of data bearing on this subject, and, while these are not yet sufficiently extensive in some directions to warrant emphatic statements on this difficult problem, I feel justified in coming to the following conclusions.

(8) *Conclusions.*—(*a*) Only *a strictly quantitative agglutination technique* is of any value in the diagnosis of an enteric infection, against which the patient has been previously inoculated.

(*b*) Any technique, in which the margin of error is not greater than *one dilution* in the series 10, 20, 40, 80, 160, is, for all practical purposes, a *strictly quantitative technique.*

(*c*) Agglutination tests, when carried out in the manner indicated, and repeated at intervals of a few days throughout the illness and convalescence, furnish extremely important information in the diagnosis of enterica in inoculated patients. The method probably provides more important information in a large number of cases than any other single method of examination.

(*d*) In many cases the results obtained not only agree with the general clinical diagnosis of enterica, but furnish, when the agglutinin response is specific, a differential diagnosis of T infection, A infection or B infection, as the case may be. *This, in my experience, is never possible, with any certainty, on clinical grounds alone.*

(*e*) The greatest difficulty of the problem arises in connexion with the interpretation of results in those cases in which there is *loss of specificity* of agglutinin responses. These cases are sufficiently numerous to make it certain that agglutination results *alone* will not furnish a uniformily accurate diagnosis of enterica in inoculated individuals (see paragraph 6).

(*f*) Agglutination, in inoculated patients, should not be regarded as a method of diagnosis *per se*. In cases in which blood culture has failed, the agglutinin results should be interpretated in conjunction with the clinical facts of the case.

(*g*) The nearest approach to uniform accuracy of diagnosis is attained in those hospitals in which the clinicians and bacteriologists work hand in hand, employing every available means of diagnosis—clinical, serological and bacteriological.

THE PREVENTION OF MALARIA IN WAR, WITH SPECIAL REFERENCE TO THE INDIAN ARMY.

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CONTENTS.

(1) Preliminary Remarks.

It would be instructive, if it were possible, to determine the loss of military efficiency produced by malaria during the present War. In making any such computation it would be necessary to know not only the number of deaths attributable to malaria (including the number of cases in which its debilitating effect conduced to a fatal result in the course of other diseases), but also the total number of men invalided on account of malaria (either alone or in combination with other diseases) and the period during which they were rendered unfit for field service.

The time has not yet arrived when this estimation can be made with any approach to accuracy, but in the writer's opinion there can be little doubt that the result of such a calculation would indicate to a degree not yet realized the profound effect exercised by malaria on military operations.

From the financial point of view, the influence of the disease on the cost of the War cannot have been less marked or less striking. Apart from the pay, the gratuities and the pensions of those temporarily or permanently incapacitated by malaria, the cost of training and equipping recruits to fill their place must have been great. In the field considerable additional expenditure must have been incurred in providing accommodation for the sick, whilst the difficulties associated with their transport and their evacuation to the base will have been accentuated. Finally, the cost of the provision of hospital accommodation along the lines of communication, in hospital ships and in "overseas" hospitals cannot fail to have been enormous.

The writer's experience during the present War has been chiefly confined to the Indian Army, and the result of numerous observations has led him to conclude that the major portion of the sickness occurring in the Indian Army is attributable either directly or indirectly to malaria. In short, it is considered to be no exaggeration to state that the prevalence of malaria amongst Indian troops is a matter calling for most serious consideration. It is probable that this statement will fail to meet with universal acceptance and that it will be considered to represent an unduly exaggerated view of the case.

The statement is indeed an unproved and therefore a valueless assertion—though some of the reasons which have led to its adoption will shortly be detailed—but it will suffice for the present argument if it be conceded that malaria is responsible for an appreciable amount of *preventable* disease. This statement of the case will, it is thought, be readily conceded, but it will be asserted that malaria is a disease which, it is well known, it is difficult or impossible to control under field service conditions and that its occurrence in these circumstances—as an acquaintance with the medical history of campaigns in malarious countries clearly proves—must be regarded as an unfortunate but inevitable result of military operations in paludic areas.

If such a view indeed be held it is undesirable that it should remain uncombated. The difficulties of controlling malaria amongst troops on field service are admittedly great and they are sometimes insuperable, but it would be to ignore the fruits of modern scientific research and the advance in knowledge of anti-malarial measures that has thereby resulted, to conclude that the experience of the Walcheren Expedition in 1809 need necessarily be reproduced in all its details over 100 years later.

It is therefore proposed to examine the problem presented by malaria in the Indian Army in the light of modern knowledge of the disease, to estimate its prevalence so far as may be and to determine whether and to what extent, and in what manner, it is possible to reduce its incidence with a view to promoting the well-being of the Army in times of peace and its efficiency in time of war.

(2) The Prevalence of Malaria in the Indian Army.

It is not proposed to detail the official statistics dealing with the prevalence of malarial fever in the Indian Army mainly on

account of the fact that the point it is sought to elucidate has reference to the *incidence of malarial infection* rather than the *frequency of attacks* of acute malaria.

The importance of making this distinction will become apparent later and it must, therefore, suffice to state here that a true appreciation of the part played by malaria in the Indian Army necessitates a knowledge not only and not exclusively of the recorded number of "attacks" of fever (which may include numerous attacks in the same individual) but also of the number of individuals whose health has been detrimentally affected by the parasite of malaria.

The writer is unaware of any statistics bearing on this point and it is, therefore, necessary to fall back upon the following personal observations which, though somewhat lacking in precision, are it is thought, sufficient to render it probable that they represent average conditions with approximate accuracy.

During a period of fifteen months, whilst the writer was serving in Muscat, reinforcements coming from India were examined as a routine measure *immediately* on arrival for evidence of chronic malarial infection. It was found that a considerable proportion of the new arrivals exhibited, in the shape of enlargement of the spleen, distinct and unmistakable evidence of old-standing infection. Thus, out of a total of nearly 300 men, some twenty-five per cent showed obvious enlargement of the spleen which was the undoubted result of malarial infection. In one particular instance no less than twenty-one out of a small draft of twenty-nine men exhibited splenic enlargement on arrival, and of these fifteen were admitted to hospital within one week with acute attacks of malaria associated with the presence of malaria parasites in the blood.

This experience may be considered—and it was so considered at the time—to be of an exceptional nature, but after return to India in February, 1916, the writer, during the succeeding twelve months, examined many hundreds of Sepoys belonging to various regiments which included Sikhs, Jats, Rajputs, Punjabi Mussulmans and Gurkhas and it was again found that a considerable—though varying—proportion of the men exhibited enlargement of the spleen with or without some degree of debility and anæmia.

It is particularly significant that many of these men were presumed to be healthy and these were only examined as a routine measure prior to proceeding on field service. They comprised the majority of those whom it was necessary to reject on medical grounds as being unfit for field service.

During the same period at various depot hospitals the majority

of the patients (except during an outbreak of mumps and measles) under treatment were invariably the subject of malaria.

Finally, towards the close of the year, the writer was attached to a regiment which had not previously been on field service. Here also malaria was the most common disease encountered *before* the regiment left India.

Thus, to take a day at random, on December 13, 1916, the total number of men in hospital was 17, of whom 6, or about one-third, were suffering from "fever" and enlargement of the spleen. There were also 7 "detained" cases (detention lasts twenty-four hours, after which the patient must be either "admitted" or "discharged") of whom 5 exhibited splenic enlargement.

In addition to these 24 patients there were 57 out-patients, which included 18 men suffering from anæmia, debility and enlargement of the spleen. Finally, 23 others were attending hospital for medicine, but doing duty, which included 7 cases of chronic malaria and enlargement of the spleen. Whilst, therefore, the official returns of this regiment for December 13 only showed 17 men in hospital, including 6 cases of malaria with enlargement of the spleen, there were in fact 104 men under treatment of whom 36 or 34·6 per cent exhibited evidence of chronic malaria.

But even these 36 men do not fully represent the true malaria morbidity on the day in question, for in the above computation only those cases of "fever" who had *also* enlargement of the spleen have been taken into account. If circumstances had permitted blood examinations to be made of all patients exhibiting "fever" it is probable that the true malaria morbidity would have been found to have been somewhat greater than thirty-four *per cent*, and it would not be far wide of the mark to suggest that it might have been as high as fifty *per cent*, of the total sickness in the regiment.

The official returns, therefore, fail to give a complete representation of the true prevalence of the disease. Thus in the above-quoted instance the actual prevalence of malaria was about six times greater than might have been gathered from a scrutiny of the official statistics.

This circumstance, it should be added, is not the result of the efforts of medical officers to burke the facts, but it is largely due to the fact that the prescribed method of preparation of the official returns fails to take into account the special circumstances connected with the treatment of a chronic disease like malaria. Thus it is not always necessary—and indeed there is not always sufficient accommodation in Indian Troops' hospitals—to admit to hospital

every case of chronic malaria. Many men report sick on account of debility, diarrhœa, or perhaps slight attacks of dysentery who, if suitably examined, will be found to be suffering from chronic malaria with anæmia and enlargement of the spleen. Others come to hospital with a history of previous attacks of slight fever, but with no other signs or symptoms of malaria except enlargement of the spleen and some degree of debility. These include many cases of so-called "latent" malaria. The majority of these cases do not require to be "admitted" to hospital for they can readily undergo treatment as out-patients.

Since, however, the official returns fail to take cognizance of any patients other than those "admitted" to hospital it follows that these returns fail to reflect the true prevalence of the disease.

Then again the association of malaria with other diseases is, in the writer's experience, marked. Thus sub-acute and chronic malaria (with a small degree of enlargement of the spleen) is often found to co-exist with attacks of diarrhœa, dysentery and other diseases; thus in a recent instance six out of eight consecutive cases of acute pneumonia treated in the regimental hospital also exhibited splenic enlargement. [Two of these men developed acute attacks of malaria during convalescence.]

These cases of so-called "masked" malaria, if appearing at all in the official returns, will be shown under the head of the disease for which they were admitted to hospital, and the fact that they are also infected with the malaria parasite will not be apparent from the official statistics.

The above observations lend support to the view that malaria is widespread throughout the Indian Army.

It is held that the official statistics do not fully represent the prevalence of *acute* malaria and, what appears to be of even greater importance, they fail to throw light on the incidence of chronic malaria or to take into account either "latent" or "masked" malaria.

It is not contended—nor was it actually found to be the case—that all Indian units are equally infected, for the degree of prevalence in any given unit would be anticipated to be dependent upon a variety of circumstances, but it is thought that the facts related above warrant the conclusion that, *quite apart from the results of infection acquired on field service*, malarial infection prevails to a degree which is at present not appreciated throughout the Indian Army.

(3) The Nature of the Malaria Problem.

It is now proposed to examine, in the light of modern knowledge, the nature of the problem presented by malaria in the Indian Army.

This army is composed of races who exhibit not only a wide divergence in caste, creed and customs, but there is an equally wide variation in the climatic and other environmental conditions to which they have been subjected during early life.

The chief recruiting ground of the Indian Army is, however, the Punjab, and it will, therefore, suffice for our present purpose to review the conditions encountered in this province in so far as they affect the problem under consideration.

As the result of the epidemiological study of malaria in the Punjab it is known that the disease is apt, from time to time, to exhibit itself as an epidemic of great magnitude so that sometimes the entire population of extensive tracts is prostrated by the disease. At this time the mortality, especially amongst children, is excessively great, whilst the health of all is seriously and often permanently impaired.

These epidemics, however, only occur at irregular intervals, usually at not less than five years; during intervening periods the disease as a cause of mortality is of relatively small importance but nevertheless in each autumn a small rise in the "fever" death-rate takes place and attacks of malaria become common throughout all parts of the province.

It is found that the disease is more common in rural areas than in towns and that it is more frequently encountered in the latter than in large cities. It is a disease of agriculturists rather than of those whose business or pleasure entails residence in the heart of a great city.

Finally it has been shown that the occurrence of famine or even of lesser degrees of economic stress is usually associated with a rise in the mortality and in the morbidity of the disease in the succeeding autumn.

It is from amongst the agriculturists of the rural areas of the province that the Indian Army is mainly recruited and since they rarely or never undergo a course of curative treatment it follows that many of them must continue to harbour malaria parasites for a long period of time.

The actual proportion of infected individuals cannot even be roughly surmised since it must necessarily vary in accordance with numerous circumstances.

In a year following a severe epidemic, for instance, it can confidently be asserted that almost every recruit from the affected tract would be infected. At other times and in other circumstances the proportion of infected individuals would be less, but in the absence of more precise observations it is only possible to put forward the general proposition that all the circumstances of the case point to the conclusion that the prevalence of malarial infection amongst recruits joining the Indian Army must at all times be considerable. As confirmatory evidence of the accuracy of this view the facts already related in regard to the prevalence of malaria infection amongst the Indian troops in India may be cited.

The next point it is necessary to discuss has reference to the question of the acquirement of infection and re-infection and the occurrence of relapses amongst these young soldiers.

In the Punjab it is known that malaria infection and re-infection is not contracted throughout the year and that, whilst the frequency of infection is subject to both annual and seasonal variation, it is chiefly, though not entirely, during the months of July, August, September and October that the disease is actively transmitted by means of anopheline mosquitoes.

In the absence of measures to prevent the access of mosquitoes the troops are therefore subjected to a variable degree of fresh infection during the course of their service. The number of infected individuals is thus maintained, the actual incidence at any given time being dependent upon the relationship existing between the number of cases that have been spontaneously or artificially cured and the number of fresh infections that have recently been acquired.

In these circumstances the onset of the "fever season"—the season favourable both to the acquirement of fresh infection and to the occurrence of relapse attacks—is associated with a rise in the malaria morbidity.

In many cases, attacks of so mild a type ensue that they fail to attract attention until the occurrence of debility, anæmia, giddiness or the onset of some intercurrent infection (such as mild dysentery) renders the individual unfit to perform his duties and thus renders it necessary for him to seek medical aid.

A considerable number of men in this condition remain on duty, or apply for and obtain leave of absence, and eventually regain, at any rate in part, their normal health without medicinal treatment. More frequently they attend hospital for a few days and then return to duty.

But should they during this period be called upon to undergo

any unusual strain, such as a prolonged and trying march in the sun, an attack of "fever" is promptly precipitated. In this manner may be explained the not uncommon occurrence of extensive outbreaks of malaria in regiments on manœuvres or on the line of march, amongst whom previously but few cases of "fever" had occurred whilst in cantonments.

To a similar train of circumstances the return to India on account of "fever" of large numbers of Indian troops, after only a few weeks' residence in Mesopotamia, must probably be ascribed.

It is well known that privations, exposure and prolonged physical strain especially under tropical and semi-tropical conditions, is apt to produce relapse attacks in malarious subjects. Their great importance in this respect has however been recently emphasized by the writer, who showed that in Muscat an important reason for the unenviable reputation of this town as a malarious locality, was the fact that the environmental conditions were of such a nature as to be exceptionally favourable to the production of repeated relapses in malarious subjects.

It was proved that for prolonged periods of time the active transmission of malaria was almost, if not completely, in abeyance, yet during this period the malaria morbidity figures continued to be great and sometimes excessive. [In this connexion the case (already quoted) in which fifteen out of twenty-one malarious subjects developed acute malaria within one week of arrival at Muscat may be cited.]

Indeed, as the result of the study of malaria at Muscat it was concluded that outbreaks of malaria under certain conditions do not necessarily or always imply that much fresh infection is being acquired.

On the contrary, it was found that these outbreaks may be independent of any fresh infection, and they may be almost, if not entirely, due to the subjection of a malarious body of troops to certain climatological, meteorological and other environmental conditions which are favourable to the production of malarial relapses.

[The writer has no personal knowledge of the conditions prevailing in Mesopotamia, but there is reason to believe that at any rate in certain localities, and during certain seasons of the year, the climatic and other circumstances are not markedly different from those prevailing in Muscat.]

In the light of these considerations the conception of the problem presented by malaria in the Indian Army may be summarized as follows :—

The Army is recruited from a population which is annually subjected, in a variable degree, to malarial infection and re-infection. During this period they rarely or never submit themselves to curative treatment, their freedom from *symptoms* being perhaps dependent upon the acquirement of a partial degree of immunity, whilst their freedom from *infection* is associated with the complete disappearance of the malaria parasite as the result of natural causes.

After enlistment in the Army the condition of affairs is not widely different. In the absence of steps to prevent the access of mosquitoes infection and re-infection continue to take place in the same manner as formerly.

A certain number of cases of malaria thus continue to occur, but in many instances, owing perhaps to their previous acquirement of a partial degree of immunity, fever of so mild a nature results that it entirely escapes detection, or it is masked by the occurrence of other diseases.

Under normal conditions little apparent harm appears to result, but should circumstances supervene such as those associated with field service in a tropical climate, a further deterioration in health results, which is either followed by repeated attacks of ague or a condition of debility is produced which eventually, either alone or associated with some intercurrent infection, renders the individual unfit to perform his duties.

The above views, the importance of which, if correct, it is impossible to over-rate, give rise to the conclusion that one of the most important methods of reducing the incidence of malaria in the Indian Army on field service comprises measures which have for their object the detection and cure of old-standing infections as well as the prevention of fresh infection of the troops serving in India.

The conclusion is of fundamental importance, since it serves to combat the view that outbreaks of malaria are the inevitable consequence of military operations in paludic countries. On the other hand, it also suggests that the elimination of all degrees of malaria infection, however slight, from the Indian Army, should form an important feature of military medical administration in India.

The object in view should indeed be to render the Army in peace time free from any appreciable number of infected individuals, for if, in addition to the malaria infections the result of *unavoidable* infection acquired on field service, a vast number of relapse attacks due to infection acquired in India also occur, the problem

presented by malaria on field service assumes formidable proportions and presents difficulties which are not a necessary concomitant of field service, and which are not capable of being readily dealt with in such circumstances.

(4) The Prevention of Malaria amongst Troops.

(*a*) *The Prevention of Malaria on Field Service.*

In view of the facts related in the preceding chapter it is clear that the prevention of malaria amongst bodies of troops comprises two distinct problems:—

(i) The prevention of infection and re-infection.

(ii) The cure of old-standing infections.

It has been shown that whilst these are both of great importance they are subject to variation in different localities and in varying circumstances. On the one hand the prevention of infection may be the main problem and on the other the prevention of relapses may be of equal or even greater importance than the former. But from the practical point of view anti-malaria measures may more conveniently be divided into the following categories:—

(*a*) The prevention of malaria on field service.

(*b*) The prevention of malaria in cantonments.

In regard to the prevention of malaria on field service it is clear that if the measures necessary to prevent infection and to cure old-standing infections have been carried out successfully in peace time the prevention of malaria on field service will solely comprise measures which have for their object the prevention of fresh infection. The solution of this problem may perhaps present difficulties, but however great these may be it will not be complicated nor aggravated by the occurrence of large numbers of relapse attacks due to infection contracted previous to the War.

A nation, therefore, which has adopted and carried out in time of peace an anti-malaria policy which has eliminated malaria from its army, will in time of war reap a reward of the first magnitude. Success will more readily attend the military operations of its forces and at a lesser cost of both blood and treasure than in the case of armies whose efficiency is prejudiced by reason of the prevalence of chronic malaria infection.

Adopting therefore for the moment the view that the army takes the field in a malarious tropical or sub-tropical country (such as Mesopotamia, the Balkans or Palestine) free from malaria infection what are the measures that can be carried out to safeguard the

troops from acquiring the disease? Clearly these must depend upon the climatic and other conditions of the locality in which the troops are serving. They must also be affected by the prevailing military necessities. In some cases, practically no measures can be taken to prevent the occurrence of fresh infection and to this extent malaria must be looked upon as the inevitable result of campaigning in paludic countries. In such category would be a military force engaged in *active* operations in the highly malarious jungles of East Africa or in other severely infected countries during the "fever" season.

In such circumstances military considerations may over-ride all others, and questions of health must be surbordinated to military necessity.

But it may happen that, warned of the risks of committing the troops to active operations in pestilential swamps, an alternative plan of campaign may commend itself to the military anthorities. An instance, indeed, is said to have occurred during the present War, where the opposing General gave ground in such a manner as to manœuvre the allied forces into highly malarious valleys from which he is reported to have said he would not endeavour to eject them as "malaria would do the work." If this statement was, indeed, made, his prescience was abundantly justified by the event, for it has been officially reported that the Allied forces operating in these valleys have been voluntarily evacuated (alas! a year too late), owing to the onset of the malaria season.

Failing the possibility of combining tactical and medical problems, it is necessary to consider what other measures may be carried out in order to mitigate or prevent the widespread infection of troops serving in highly malarious areas. It is obvious that if the troops can be protected from the bites of mosquitoes, the transmission of the disease will be rendered impossible. Much time, money, and ingenuity has been expended in endeavouring to comply with this desideratum; masks for the face, gloves and leggings for the extremities, have been provided, dug-outs have been fumigated, or they have been protected by netting, whilst a mosquito net has been added to the kit of the already over-burdened soldier.

None of these or many other similar contrivances have in actual practice proved successful, nor as long as troops are in daily contact with the enemy is it probable that preventive measures of this nature can be carried out with reasonable efficiency.

In these circumstances it would appear that the only possible method of safeguarding the health of the troops is by means of the exhibition of quinine in prophylactic doses.

This measure has also been tried with a success which has varied to a marked degree; in some cases the drug has apparently completely failed to achieve the object in view, whilst in others a gratifying measure of success has attended its exhibition.

In the writer's hands, as the result of an experiment carried out amongst school children in the Punjab, the prophylactic use of quinine has yielded results of the greatest value, and provided that certain principles are acted upon, there is reason to believe that quinine is a drug capable of yielding, if certain precautions be observed, profoundly beneficial results which, moreover, are attainable even under the exacting conditions of active military operations.

The principles underlying successful quinine prophylaxis are as follows:—

(1) Owing to the fact that quinine is almost completely eliminated from the system within forty-eight hours, the drug requires to be exhibited at intervals of not less than this period.

(2) The amount of quinine requires to be varied in accordance with the intensity of local malaria, and in places where the disease is highly endemic a daily dose of not less than ten grains of quinine should be given to adults.

(3) In the case of malarious subjects it is not reasonable to expect that quinine given in *prophylactic* doses will suffice to prevent the occurrence of relapses as well as the acquirement of fresh infection. In such cases the patient requires to be placed on a *curative* system of treatment.

(4) The arrangements for the exhibition of the drug must be of a nature which will ensure that the quinine either in liquid or tablet form is consumed with regularity.

(5) The prophylactic use of quinine may, if circumstances permit, be combined with anti-mosquito measures, but the energies of medical officers and others must not thereby be distracted from prosecuting the main line of defence, viz., the inauguration of an efficient system of quinine prophylaxis.

(6) In countries possessing a sub-tropical climate, in which the active transmission of malaria is confined to a certain season of the year, the above procedure need only be continued during the malaria season.

But the troops are not always engaged in active operations and it will often happen that they will be under conditions not markedly different from those prevailing in peace time. In such circumstances it will be possible to carry out to a variable degree the measures (to be shortly detailed) applicable to troops serving in cantonments.

Thus much may often be done by the careful selection of camping grounds to reduce the opportunity of acquiring infection in permanent camps. These camps, therefore, should not be laid out in malarious countries without a previous survey of the locality by a malaria expert.

It may happen that there is no alternative between camping alongside a malarious swamp and forming a camp in an open desert two or three miles from water. But it may equally be that the provision of a pipe water supply to such a camp would in the long run be a cheaper and more efficacious method of safeguarding the health of the troops than permitting them to camp alongside the swamp, even though an extensive and necessarily expensive antilarval campaign should be initiated.

The measures suitable and proper under peace conditions, however, constitute a large and important programme which cannot readily be carried out on a large scale under field service conditions.

It thus comes about that if, in addition to the malaria cases, the result of infection acquired on field service, a large number of relapse attacks, due to infection acquired in peace time, have to be dealt with, not only will the efficiency of the force be seriously prejudiced but the medical organization throughout its whole length from the front line to the base will be subjected to a severe strain.

(b) *The Prevention of Malaria in Cantonments.*

Although the antimalaria measures that may appropriately be adopted in cantonments during peace times are discussed here, some of these measures may equally be carried out in war time, more especially in the case of troops stationed on lines of communication or on garrison duty at the base.

In view, therefore, of the fact that malaria infection is rife amongst many of the units of both the British and the Indian Armies that have served in India or in the Eastern theatre of war it will be clear, from what has gone before, that the percentage of wastage in the front line, and the maintenance of the efficiency of field armies generally, will be dependent upon the extent to which these measures are capable of being carried out during the course of the war.

(i) *Curative Measures.*—It is obvious that an accurate knowledge of the incidence of malaria must necessarily precede the adoption of curative measures, but it has been shown that in the case of the Indian Army the true prevalence of the disease is not fully disclosed

by the official statistics. It would, therefore, appear to be essential that steps should be taken to place the diagnosis of malaria in Indian troops on a more satisfactory footing. For this purpose it would appear to be essential that in each regimental hospital both the medical officer and his subordinates should not only be competent to carry out the simple procedure involved in making a microscopical diagnosis of malaria, but that they should be provided with the necessary equipment for so doing.

This equipment is indeed required not only for the diagnosis of malaria but for the detection of many other diseases common amongst Indian Sepoys, not as a substitute for divisional laboratories but to supplement them in matters of everyday routine.

But even in the absence of these facilities there exists in the "spleen test," provided it is properly carried out, an exceedingly simple, rapid and fairly accurate means of detecting chronic malaria, which, moreover, can be carried out under almost any conditions. The value of the test is well known and many reports have been published, especially during recent years, in regard to its importance both as an aid to diagnosis and as a guide to treatment. So far as is known, however, the attention of medical officers has not been directed to the value of this test and from the writer's experience it would appear to be both little known and but little appreciated.

It is, therefore, not out of place to detail the procedure. It is usually quite useless in the case of an adult, to carry out the examination in the upright position. The patient should be placed on a bed or couch in the supine position with the thighs flexed. The examiner standing on the *right* side of the patient lightly palpates the abdominal wall below the left costal margin with the right hand. If the spleen cannot be felt the patient is asked to distend the abdomen by taking a deep breath and then slowly to relax it by means of a prolonged expiration. The spleen, if enlarged appreciably, will then usually be found to descend below the costal margin with inspiration and to slip back during expiration. By the adoption of these two methods, or even of the latter alone, the true prevalence of malaria in a unit can be quickly ascertained.

In the case of Indian units it is important that *every* man attending hospital should be examined in this manner, for by so doing many cases of chronic malaria will be discovered. It is also desirable that *every recruit* on *enlistment* should be similarly examined.

These procedures, more especially the spleen test, offer no

difficulty in execution and the writer has found it possible to carry them out both on field service and in Indian cantonments.

The next point consists in entering the names (by companies) of malarious subjects in a special register—the "Malaria Register," in which the size of the spleen, the presence or absence of parasites and their species, if detected, should be noted.

Armed with the information contained in this register the treatment of the disease can now be carried out in a systematic manner.

With this object the patient's name should be entered in a "Quinine Register," and he should also be given a "Malaria Card," showing the nature of the infection, the dose of the drug and the period during which the "treatment" should be carried out.

A difference of opinion may exist in regard to the exact dose of quinine and the length of time during which it should be administered (and experience shows that both of these data may be varied in different cases) but it is at any rate certain that an occasional dose of quinine given at irregular intervals during the few days following an attack of ague is not calculated to effect a cure.

It may be that finality has not yet been reached in regard to this question, but the writer can state as the result of a prolonged and carefully controlled experiment carried out in Indian troops at Muscat that the following method of "treatment" and "after-treatment" is capable of yielding highly satisfactory results.

A.—Treatment.

1st week	(i) During continuance of fever (usually not more than three days)	Quin. bi-sulph. gr. x, t.d.s. in solution.
	(ii) For the four following days	Ditto.
2nd „ ..	(iii) For one week whilst "attending" hospital..	Ditto. Bis die.
3rd „ ..	(iv) For one week whilst on "light duty" ..	Ditto.

B.—After-treatment.

	(v) On discharge to duty	Ditto. Once daily for 4—6 months.

When possible it is preferable that the drug should be administered on parade and that the attendance at this parade should be noted daily in the quinine register. In cases where this is impossible the soldier should be provided with quinine in tablet form and he should be instructed to take the requisite number of tablets daily.

If the soldier suffers from an attack of fever, or is in need of quinine whilst absent on leave or on detached duty, he should be

instructed to present the "malaria card" to the appointed medical attendant who will thus be in a position to carry on the treatment with a full knowledge of the man's past history.

(ii) *Prophylactic Measures.*—It now remains to consider the measures necessary to prevent the acquirement of fresh infection.

Of these the prevention of access of mosquitoes is a measure of the first importance, but at present, except in the case of War Hospitals and of troops stationed in Burma (where mosquito nets are issued at the rate of 1½ per cent of strength) Indian troops are not provided with mosquito nets as a Government issue and it is left to the regimental authorities to provide them if they have the funds and the inclination to do so.

It is, however, one thing to provide nets and another matter to ensure their proper use. In the writer's experience nets are rarely used properly by the Indian Sepoy; they are frequently removed at night on account of the heat and, when used, they are often faultily applied. The mosquito net is moreover a fragile structure and care and constant attention are necessary if it is to prevent effectively the ingress of mosquitoes. It is obviously insufficient and indeed it is useless to provide mosquito nets unless steps are taken to see that they are properly used.

It is for officers to set an example to their men in this respect, both by precept and by example, for if the former are not firmly convinced in the efficacy of the mosquito net it is scarcely to be expected that the latter will exhibit greater wisdom.

In each locality the malariologist will be able to determine the period of the year during which mosquito nets should be used, and it should be made obligatory on all ranks to use them during this period.

But experience shows that the use of mosquito nets by troops is fraught with many difficulties, and it would appear to be preferable from the point of view of efficiency, as well as of comfort, that other means should be adopted to prevent the access of mosquitoes. It has elsewhere been suggested by the writer that in the case of bodies of men the protection afforded should take a collective rather than an individual form.

Such an arrangement might consist of screened enclosures of wire gauze (fitted in their interior with electric fans or punkahs) erected in the vicinity of barracks.

In the case of troops on field service, other than those serving in the front line, the use of a mosquito net is a most valuable as well as a practicable means of preventing malaria infection.

Unfortunately, its advantages are not fully appreciated and it is but rarely efficiently used.

If all the malarious subjects are treated on the lines already outlined, and if the acquirement of fresh infection is prevented by the use of measures to prevent the access of mosquitoes, little need will arise, at any rate, under normal peace conditions, for the exhibition of quinine in prophylactic doses. But if circumstances prevent the adoption of these measures, either in whole or in part, it may be advisable to carry out quinine prophylaxis during the "fever" season in the manner already described.

If, however, the outbreak of malaria is the result of relapse attacks, following old-standing infections, it would be clearly unnecessary to exhibit the drug indiscriminately to entire units. In such circumstances it would suffice to adopt this procedure only in the case of those individuals whose names appear in the malaria register.

Finally it is important, more particularly at the season of the year when relapses are common and during the early stages of a curative course of treatment, that all causes likely to lower the powers of resistance of the individual should, so far as possible, be avoided.

Thus in the case of a malarious unit, attention to the general health, the provision of an ample supply of suitable food, the avoidance of undue fatigue and excessive exposure to the sun and the prevention of chills are all anti-malaria measures of considerable value.

(5) Conclusion.

A consideration of the facts given in this paper suffices, it is thought, to establish the view that not only is malaria far more prevalent in the Indian Army than is generally recognized, but that the time has arrived for a radical alteration to be made in the methods of grappling with the problem of its prevention.

The important point has also been established that on the thoroughness of the preventive measures carried out in time of peace the efficiency of the army in time of war is largely dependent.

It has also been shown that malaria is not necessarily an inevitable result of military operations in paludic countries, and that the scientific application of modern knowledge of the disease renders it possible to mitigate in great part the sickness and inefficiency to which malaria gives rise.

If these conclusions are well founded it is difficult to over-estimate their importance, for they serve to enunciate general principles on which the anti-malaria policy of the future should largely be based. But it is hoped that this paper will also serve an immediately useful purpose by directing the attention of medical officers serving for the first time in malarious countries to the importance and difficulties of the problem presented by the prevention and treatment of malaria in time of war.

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THE BRILLIANT GREEN ENRICHMENT METHOD FOR THE ISOLATION OF THE PARATYPHOID BACILLI FROM FÆCES.

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LITTLE need be said in this communication as to the value of the brilliant green enrichment process for the isolation of *Bacillus typhosus* and the paratyphoid bacilli from fæces. It has been generally accepted as superior to the ordinary methods of direct plating on differential solid media, but there appears to be considerable variation in the actual methods of application of the enrichment process adopted by different bacteriologists.

In the original papers on the subject by Browning, Gilmour and Mackie [1] and Browning, Mackie and Smith [2], the use of varied amounts of brilliant green was described as an essential feature of the method owing to the variation in the optimum amount appropriate for obtaining the maximum growth of the typhoid bacilli from different specimens of fæces. Lately, however, the method has been abbreviated by certain bacteriologists to meet the demands of a busy laboratory especially in the examination of large numbers of suspected "carriers." This abbreviation has generally consisted in limiting the inoculation to one tube containing 0·4 or 0·5 cubic centimetre of a 1 in 10,000 watery solution of brilliant green in ten cubic centimetres of peptone water. While this modification may still yield better results than those obtained by direct plating, it is open to fallacy and is often misleading where comparisons are made between the enrichment process and other methods.

Where it is essential that the most thorough technique should be employed in the isolation of typhoid bacilli, no reasonable amplification of an isolation method can be neglected provided that the extra time devoted to it is likely to repay the worker by his obtaining more successful results. Thus a further modification of the original method intended to obviate the possibility of overgrowth of *B. typhosus* by certain types of *B. coli* which were more resistant to brilliant green than the typical coliform bacilli, i.e.,

the use of tellurate of soda[1] in conjunction with brilliant green, was demonstrated by Browning, Mackie and Smith to represent a further advance in the selective enrichment of *B. typhosus* in fluid medium. The importance of this modification has been recently alluded to in the *British Medical Journal* (Browning and Thornton [4]).

As was originally pointed out, however, by Browning, Mackie and Smith, the use of tellurate was applicable only as regards the isolation of *B. typhosus* and *B. paratyphosus* A, and it was shown that *B. paratyphosus* B was relatively non-resistant to tellurate in the amounts employed—a rather striking distinction between the two paratyphoid bacilli.

In the routine bacteriological investigation of fæces carried out in the Central Bacteriological Laboratory at Alexandria during the paratyphoid prevalence of 1915-1916 in the M.E.F., where the great majority of "enterica" infections were due to *B. paratyphosus* A and B, the original brilliant green method was systematically employed and in all cases varying concentrations of brilliant green in peptone water were inoculated. The object of this short note is to demonstrate the necessity of adhering to the original method if uniformly satisfactory results are to be obtained and the fallacy of using any abbreviation or "one tube" method.

As regards the details of the technique: a dense and uniform emulsion of fæces was made in sterile 0·85 per cent salt solution and from this the tubes of peptone and brilliant green were inoculated. In general a large loopful (0·4 cubic millimetre diameter) of the emulsion was added so that a fairly heavy inoculation resulted. In the case of diarrhœal stools the amount added to the tubes depended on the density of the specimen: if very watery in consistence, three or four loopfuls were used for the inoculation of each tube; if, on the other hand, the specimen was of greater density, one loopful was sufficient. The tubes were then incubated at 37° C. Subcultures were made never later than twelve hours (and sometimes as early as seven or eight hours) on MacConkey's bile salt lactose agar. In Clarke and Stokes' procedure [5] the tubes were heavily inoculated and the subcultures made not later than nine hours after. Torrey [6] used a fixed amount of brilliant green but varied the amount of fæces introduced. Though here allowance is made for the variation in the optimum adjustment of

[1] More recently Browning and Thornton [3] have used telluric acid instead of tellurate of soda.

the amount of fæces in relation to the amount of brilliant green, it is doubtful if this procedure is likely to elicit the best results if the enteric organisms are scanty. It seems more rational to use varying amounts of brilliant green and inoculate each tube heavily. This is specially important in virtue of the varying resistance of the typhoid and paratyphoid bacilli to the action of the dye.

Where the number of typhoid or paratyphoid organisms in the specimen is likely to be relatively small it is undoubtedly essential to inoculate with the maximum amount of fæces, for on this depends the special value of any enrichment method. If the typhoid bacilli are present in the amount of fæces used for a "light inoculation" they could probably be isolated by the direct methods, so that in such cases the only advantage of employing an enrichment process would be increased facility of "picking off" suspicious colonies on the subculture plates owing to their relatively increased number, or their presence in practically pure culture.

If a "one-tube" modification is used it will be impossible to obtain uniformly good results with heavy inoculation for, especially if the bacterial content is great, the typhoidal bacilli may be overgrown by the more resistant types of *B. coli*. It, therefore, becomes more essential, especially if heavy inoculation is resorted to, that varying amount of the dye should be used.

The amounts I generally used were: (1) 0·25 cubic centimetre; (2) 0·40 cubic centimetre; (3) 0·65 or 0·7 cubic centimetre of a 1 in 10,000 solution in distilled water, freshly made from a stock 1 per cent solution.

The following typical examples of the bacteriological results obtained in cases where *B. paratyphosus* A and B were isolated by the brilliant green method serve to illustrate the importance of the actual method of application of the enrichment process. In the cases quoted the brilliant green method was also controlled by direct plating on MacConkey's medium and the results show the striking superiority of the enrichment method where varying concentrations of brilliant green were used.

(1)

Brilliant green 1 in 10,000 in 10 c.c. peptone water	Resulting growth after eight hours when plated on MacConkey's medium
0·25 c.c.	Practically pure growth of *B. paratyphosus* A.
0·40 c.c.	Scanty growth of atypical *B. coli*.
0·60 c.c.	No growth.

ON DIRECT PLATE NO B. PARATYPHOSUS A COLONIES DETECTABLE.

Here a "one tube" method containing 0·4 cubic centimetre of brilliant green solution would have completely failed to yield any result, whereas a practically pure culture of *B. paratyphosus* A was obtained in the tube containing 0·25 cubic centimetre of the dye. On the plate inoculated direct from the fæcal emulsion no paratyphoid colonies were detectable, showing that this organism was present in relatively small numbers.

(2)

Brilliant green 1 in 10,000 in 10 c.c. peptone water	Resulting growth after twelve hours when plated on MacConkey's medium
0·25 c.c.	Typical *B. coli*.
0·40 c.c.	Mixed growth of *B. coli* and *B. paratyphosus* A.
0·70 c.c.	Practically pure growth of *B. paratyphosus* A.

ON DIRECT PLATE NO B. PARATYPHOSUS A COLONIES DETECTABLE.

In this instance 0·4 cubic centimetre of the brilliant green solution was sufficient to enrich the paratyphoid A bacilli to a certain extent, but a larger amount of 0·7 cubic centimetre elicited a practically pure culture of this organism. This result was also obtained from a specimen of fæces which showed no suspicious colonies on direct plating.

(3)

Brilliant green 1 in 10,000 in 10 c.c. peptone water	Resulting growth after eight hours when plated on MacConkey's medium
0·25 c.c.	*B. coli*—atypical.
0·40 c.c.	*B. coli*—atypical.
0·65 c.c.	Atypical *B. coli* and *B. paratyphosus* B mixed growth.

ON DIRECT PLATE NO B. PARATYPHOSUS B COLONIES DETECTABLE.

This result is interesting in that no typical *B. coli* grew from the brilliant green tubes, but in all the tubes there was an abundant growth of atypical *B. coli* which were apparently relatively resistant to the dye. The highest concentration of brilliant green, however, seemed to be sufficiently inhibitory to allow the paratyphoid bacilli to multiply though not sufficient to completely stop the growth of the coliform organisms.

(4)

Brilliant green 1 in 10,000 in 10 c.c. peptone water	Resulting growth after ten hours when plated on MacConkey's medium
0·25 c.c.	*B. coli*—atypical.
0·40 c.c.	*B. coli*—atypical.
0·60 c.c.	Atypical *B. coli* and *B. paratyphosus* A mixed.

Two B. paratyphosus A colonies detectable on direct Plate.

This shows a similar result in the case of *B. paratyphosus* A.

(5)

Brilliant green 1 in 10,000 in 10 c.c. peptone water	Resulting growth after eight hours when plated on MacConkey's medium
0·25 c.c.	Practically pure growth of *B. paratyphosus* B
0·40 c.c.	Ditto
0·60 c.c.	Ditto

On direct Plate a few colonies of B. paratyphosus B detectable.

In this case, though the paratyphoid colonies were present on direct plate, all concentrations of brilliant green produced a practically pure growth of this organism. This, of course, rendered the detection of the organism much easier than by the ordinary method.

(6)

Brilliant green 1 in 10,000 in 10 c.c. peptone water	Resulting growth after eight hours when plated on MacConkey's medium
0·25 c.c.	*B. coli.*
0·40 c.c.	Mixed *B. coli* and *B. paratyphosus* A.
0·60 c.c.	Growth of atypical *B. coli* of *B. lactis aerogenes* type.

No B. paratyphosus A colonies detectable on direct Plate.

In this case the optimum amount of brilliant green was 0·4 cubic centimetre, a higher amount 0·6 cubic centimetre produced complete inhibition of the paratyphoid bacilli and favoured the growth of the more resistant coliform organism in the fæces. This is a striking instance of the careful adjustment necessary for the most satisfactory result. It is remarkable how slight variations in the amount of brilliant green affect the characters of the resulting growth, certain amounts favouring the growth of one type of organism at the expense of another. This was well shown in the original papers on the method (Browning, Gilmour and Mackie).

As will be seen from these examples the optimum amount of

brilliant green necessary to elicit the maximum growth of the typhoidal bacilli varies with each specimen of fæces though lying within a certain range, i.e., from 0·25 cubic centimetre to 0·7 cubic centimetre of a 1 in 10,000 solution, and the resulting bacterial growth may be completely altered by even slight variations in the amount of the reagent used. On what this peculiar variability depends it is difficult to say; probably qualitative and quantitative variations in the bacterial content; difference in the resistance to brilliant green of the particular strains of *B. typhosus* and the paratyphoid bacilli and perhaps differences in the chemical composition of fæces.

Quite recently, Leitch [7] has demonstrated the great value of the brilliant green method in the detection of carriers. Thus several cases were demonstrated to be paratyphoid B carriers by the brilliant green method when the paratyphoid colonies could not be detected on direct plates.

The cases quoted in this short note in which the brilliant green method was controlled by simultaneous direct plating is a further demonstration of the superiority of this process provided a complete method is used. In cases (2) and (6) the abbreviated procedure would have been equally successful with the original method, but in cases (1), (3) and (4) the "one tube" modification would have failed to produce a positive result. Moreover, in case (4) a positive result would have been obtained by direct plating, while the short method would have yielded a negative result.

Of course, in a great many instances the typhoid and paratyphoid bacilli can be isolated by direct plating, but in all such cases the preliminary enrichment in brilliant green peptone water is likely to render the detection of suspicious colonies much easier and so ensures greater certainty in the actual isolation of the enteric organisms. This feature alone has proved of the greatest importance in recent experiences with the brilliant green process and represents, apart from other consideration, a striking advantage of the method.

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CASES OF MENINGOCOCCUS SEPTICÆMIA.

By Captains W. ANDERSON, J. W. McNEE, H. R. BROWN, ARNOLD RENSHAW, JAMES McDONNELL, F. C. DAVIDSON, and Major A. C. H. GRAY.

WITH NOTE

By Colonel HERRINGHAM.

Consulting Physician.

Cases in which the meningococcus produces fever and death by multiplying in the blood without, apparently, attacking the meninges are sufficiently uncommon to deserve record. We have had three proved and one probable case lately.

The first case was not seen by me, and its nature was not known until the blood culture supplied the evidence.

Case 1.—*History unknown. Severe illness; temperature subnormal; pulse and respiration rapid; bronchitis; large purpuric rash; fever, coma, death on second day after admission. No post-mortem.*

No. 14611, Private A. was admitted to a casualty clearing station on February 11, 1916, with a diagnosis of "influenza." No history of the illness accompanied the patient, who was obviously very unwell. On examination, his temperature was found subnormal, and the most pronounced physical signs of disease were present in the chest, where abundant râles were heard everywhere on auscultation. No area of consolidation could be made out, and the heart's sounds were inaudible, owing to the chest condition. Next morning, February 12, a number of definitely purpuric spots were found to have developed during the night. These were first noticed on the front of both thighs and both legs, but later smaller spots were visible on the chest and lower part of the back. One patch on the outer side of the right thigh was as large as a man's hand, and deep purple-red in colour. The pupils were equal, no vomiting occurred, and no rigidity of the neck or alteration in reflexes, such as are looked for in a case of meningitis, were apparent. A blood culture was taken on this day, the result of which is referred to below. The pulmonary symptoms gradually became worse, and by 11 p.m. the man was unconscious, and evidently dying. He lingered on, however, until 6 a.m. the following morning, February 14, when death occurred. During the

twenty-four hours preceding the fatal issue the temperature steadily rose (*see* chart).

Result of Blood Culture.—Five cubic centimetres of blood were taken into about thirty cubic centimetres of bouillon. No growth was evident after forty-eight hours' incubation, but on the third day growth was seen to have occurred. On microscopic examination Gram-negative diplococci, morphologically resembling meningococci or gonococci, were found to be present in pure culture. Subcultures were obtained on serum agar and on brain agar, but not on ordinary

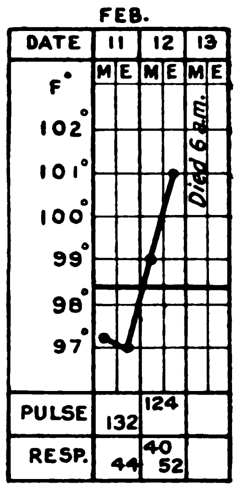


CHART 1.

agar. The "sugar reactions" of the organism were then tested, and it was found to give those of the meningococcus, namely, acid production with glucose and maltose, but not with saccharose.

In order to complete the identification of the organism as thoroughly as possible, a subculture was sent to Captain A. W. M. Ellis (Canadian) Mobile Laboratory, to test the "type" reaction of the organism. Captain Ellis found (using his method detailed in the *British Medical Journal*, December 18, 1915), the organism to belong to Type II, which also correspond to the Type II in Gordon's classification.

W. ANDERSON, *Captain, R.A.M.C.*
J. W. MCNEE, *Captain, R.A.M.C.*

The second case was not seen by me. Meningococcus septicæmia was not suspected during life, and the cultures taken post-mortem

proved sterile. But the clinical history so closely resembles the others, and the petechial appearance of the stomach is so very similar to that seen in Case 3, that I have little hesitation in placing it in this group.

Case 2.—One week malaise, then severe illness with rapid pulse and respiration. Purpuric rash. Hæmatemesis. Death about third day of severe symptoms.

No. 35, Staff-Serjt. E., aged 25. Patient was admitted to a general hospital on March 16, 1916, as being a possible case of cerebrospinal meningitis. Lumbar puncture had been performed, previous to his admission, at the British Isolation Hospital.

Clinical Note accompanying Patient.—"Hyperpyrexia, mental stupor, subcuticular hæmorrhages. Had anæsthetic at 4.45 for lumbar puncture." Fluid was under pressure and has been sent to Canadian Mobile Laboratory.

Pathological Report from Canadian Mobile Laboratory.—"Spinal fluid. No. 35, Staff-Serjt. E. Clear, cell counts thirty-two polymorphonuclears and large endothelial cells. Culture positive. Staphylococcus."

On admission to the general hospital (March 16, 1916), at 8 p.m., he was in a collapsed condition; pale, dyspnœic and slightly delirious. He gave a history of about one week of illness with "pains all over." Shortly after admission he vomited some brown fluid with the "coffee grounds" appearance suggestive of gastric hæmorrhage. His face, trunk and limbs were blotched with purplish purpuric spots at wide intervals, varying in size from a pin's head to a threepenny piece. There was no other evidence suggestive of cerebrospinal meningitis, the neck moving freely. Temperature 99° F. The pulse was rapid, feeble, and could not be accurately counted; the area of heart-dullness could not be accurately gauged owing to an emphysematous chest, but it was obvious that the heart was failing. Heart sounds feeble and distant, no murmurs detected; no peripheral œdema. Brandy $\frac{1}{2}$ ounce hourly, hot, and with sugar, was ordered, and morphia $\frac{1}{4}$ grain with atropine $\frac{1}{100}$ grain, in the hope of controlling the extreme restlessness, was given at 10 p.m. At 1 a.m. morphia $\frac{1}{4}$ grain was repeated, but failed to quiet the patient who was becoming rapidly worse. Patient vomited again at 4.30 a.m. (March 17, 1916). At 6 a.m. temperature was 104° F., pulse 144, respirations 24. At 6.15 a.m. death took place.

Post-mortem.

Body very well developed and covered. Rather excessive subcutaneous and omental fat for a young and healthy man. Extensive purpuric staining and blotching of skin of face, trunk, and particularly of extremities.

Alimentary System.—Small petechiæ in serous and mucous surfaces of stomach, into which there had been some oozing of blood, a little altered blood being present. A few petechiæ in serous and mucous surfaces of small intestines. Peyer's patches very well marked but not swollen or ulcerated. No unusual enlargement of mesenteric glands. Spleen enlarged and slightly diffluent suggesting so-called "septic spleen."

Circulatory System.—Heart large and very flabby; muscle pale; mitral ring dilated, taking three fingers; no valvular disease.

Respiratory System.—Lungs much congested and œdematous; extensive old pleuritic adhesions on both sides posteriorly.

Excretory System.—Kidneys showed cloudy swelling.

Nervous System.—No vertical or basal lymph or pus. No distension of ventricles. No apparent injection or congestion.

Pathological Report.

Culture of heart blood, on blood agar and bile salt broth both quite sterile.

Spleen, on blood agar and bile salt broth both quite sterile. Gall-bladder, in bile salt broth showed *B. coli.* Cultures were made about fourteen hours after death.

Histology.—Lung shows marked œdema and some bronchopneumonia.

Liver shows: (*a*) A few points of focal necrosis; (*b*) fatty degeneration; (*c*) congestion; (*d*) slight increase of fibrous connective tissue in portal area.

Kidneys show acute parenchymatous nephritis affecting chiefly the tubules, but also a few of the glomeruli.

There is no apparent infiltration of the interstitial tissue. Spleen shows a few small areas of focal necrosis. No definite organisms could be recognized in section of the spleen and liver stained by Gram's method.

(*Signed*) ARNOLD RENSHAW, M.D.
Captain, R.A.M.C.

The third and fourth cases I saw in consultation with the officers of a casualty clearing station. Though they occurred within a day of each other the two cases were entirely unconnected.

Case 3.—*Illness beginning with pain in head and back, vomiting and high fever, followed by collapse, rapid pulse and respiration; delirium and death on fourth day. Very marked purpuric rash.*

Corporal W., aged 22, was admitted to a casualty clearing station at noon, March 18, 1916, from a field ambulance, with the following notes:—

"Corporal W. was admitted to ambulance late last night, temperature 104° F. Pulse imperceptible at wrist. He slept a little during the night and the temperature fell. He became cold and collapsed. This morning he states he feels better, but his condition is still serious. The radial pulse cannot be felt, but the heart's action is rapid and the first sound very faint. There was some vomiting yesterday."

On admission to the casualty clearing station he stated that he had been unwell since the 15th. On that and the following day he was unable to ride owing to severe pain in the small of the back and frontal headache. He was a well-developed, muscular man.

On admission he was cold and collapsed. The radial pulse could not be felt. He was breathing very rapidly. He complained of pain at the back of the eyes, of frontal headache, and of pain in the back at the level of the shoulder blades.

Tongue dry. Conjunctiva inflamed. No stiff neck, no rigidity of the back muscles, no incontinence of urine or fæces. Pupils were equal and reacted normally.

Nothing abnormal to be found within chest or abdomen, but scattered over all trunk and limbs is a most noticeable hæmorrhagic rash, which he says has been present for two days.

This rash on the chest and abdomen is comprised chiefly of small spots about the size of the head of a large pin, but on the legs the rash has more the appearance of large bruises, being particularly extensive around the knee, ankle, and elbow joints. On the buttocks there are several of these large spots to be seen, and on the back there are a few scattered ones. No rash on the face. He received ordinary treatment for shock.

2 p.m.: Warmer and more comfortable, pulse not felt at wrist. Rate of respiration increased. Anæsthetized with chloroform. Lumbar puncture done. Fluid drawn off perfectly clear and under

very low tension. Bacteriological examination subsequently proved it to be sterile. A specimen of blood was now taken from median-basilic vein of right arm. This specimen subsequently gave a culture of *diplococcus intracellularis.* Returned to bed. Rate of respiration continued to increase to 56 per minute.

Restless and sleepless, ordered R. pot. brom. 30 grains, chlor. hydrate 20 grains.

March 19, 1916: He had a bad night, was drowsy but did not sleep; was rambling a good deal. Pulse at wrist now felt about 140 per minute. The speech was noticeably "slurry"; he is still delirious, says he feels quite well, and that all pains have left him.

2.30 p.m.: Intravenous injection of fifteen cubic centimetres polyvalent anti-meningococcic serum (Lister Institute).

During course of evening patient became extremely restless, and during small hours of morning great difficulty was experienced in keeping him in bed. He died at about 2.30 a.m., March 20, 1916, after a great struggle.

Post mortem.

The rash was very marked with large blotches on the limbs and smaller spots on the trunk.

Lungs, natural.

Heart, a few petechiæ on the surface near the right border; otherwise natural.

Liver, large, soft, and with a few pale patches; otherwise natural.

Spleen, large and soft.

Kidneys, soft and congested.

Stomach and duodenum. In the cardiac part of the stomach there was an area of about four inches square, in which the mucous membrane was covered with petechial hæmorrhage. There were a few scattered in other parts of the stomach also. A similar hæmorrhagic condition was seen in the upper part of the duodenum. The œsophagus was natural.

Intestines, remainder natural.

(*Signed*) JAMES MCDONNELL,
Captain, R.A.M.C.

Bacteriological Report.

Lumbar puncture, 3.45 p.m., March 18, 1916.

Cerebrospinal Fluid.—Clear and normal in appearance. It came out in separate drops, so that the pressure was evidently

not above the normal. Twenty-five cubic centimetres were removed.

Cultures from Cerebrospinal Fluid.—About three cubic centimetres of the cerebrospinal fluid was, at the time of the operation, run straight into serum broth. The culture remained sterile.

Ten cubic centimetres of the cerebrospinal fluid, in a sterile tube, was incubated, subcultured, and examined by dark ground illumination every twenty-four hours for four days, it remained sterile.

Ten cubic centimetres of the cerebrospinal fluid was centrifuged for five minutes. No deposit could be seen at the bottom of the centrifuge tube.

A microscopical examination of the last drop left in the tube after emptying was negative.

Blood culture (4 p.m., March 18, 1916) :—

Three tubes of bullock heart trypsin broth were inoculated with 0·5 cubic centimetres, and 1·5 cubic centimetres respectively of blood from patient's arm.

After forty-eight hours incubation, diplococci could be seen, in apparently pure culture, in all three tubes by dark ground illumination.

Subcultures made on blood agar showed colonies typical of the meningococcus. Films made from the growth showed a Gram-negative diplococcus quite typical in appearance.

Post-mortem Examination.

Cultures were made post-mortem from the heart's blood, but these showed contamination.

Cultures made from the spleen gave a good growth of typical meningococcus.

Blood films showed a marked polymorphonuclear leucocytosis.

(*Signed*) A. C. H. Gray,
Major, R.A.M.C.

Case 4.—Catarrh for a week. Urticaria. Then high fever with rapid pulse and respiration. Purpuric rash, Stupor. Death on third day of fever.

Second Lieutenant H., admitted March 19, 1916, as "influenza." On March 10 complained of " nosey cold."

March 13: Urticarial rash all over body; very itchy; took calomel; rash disappeared next morning, but returned next night.

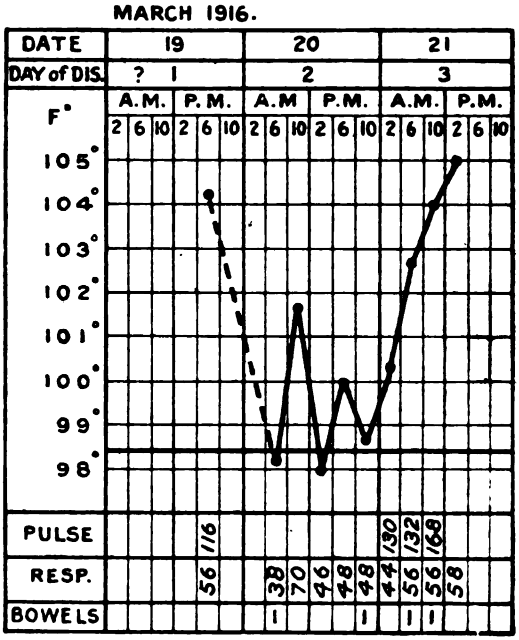


CHART 2.

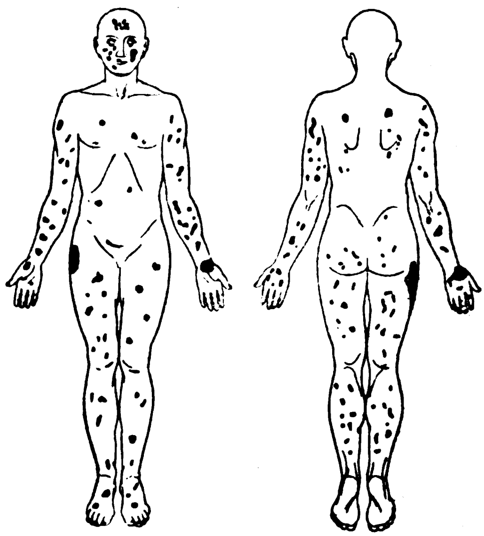


CHART 3.

March 16: Sick in quarters for four days.

March 17: Was on parade.

March 18: Was on parade, but feeling "out of sorts"; sore throat and headache.

March 19, 1916: Date of admission. Diagnosis "influenza." On admission, temperature 104·6° F.; pulse 112; respiration 56. Complains of no pain; pulse very irregular; slight prolongation of expiratory sounds; calomel, three grains given; mist. alba, ℥i.

March 20, 1916: Early this morning a diffuse purpuric rash appeared on face, arms, and legs especially; large patch over right trochanter, and large patches on both wrists; very few on chest and abdomen. Dusky purple in colour. With appearance of rash temperature fell to normal, and patient was very collapsed; radial pulse imperceptible. Distribution of purpuric rash: Most marked on (1) arms; (2) legs; (3) face. Least marked on (1) anterior chest; (2) abdomen. Patient was at once isolated on suspicion of *cerebrospinal fever*. Slight headache was complained of. Slight drowsiness was observed. No head retraction or rigidity of neck muscles. Kernig's sign absent. Tongue thickly furred and dry; knee-jerks not exaggerated; muscles very tender; much pain when limbs were moved; vomiting not of cerebral type, only on administration of fluids, e.g., milk and soda; digitalin, $\frac{1}{100}$ grain given. Saline per rectum.

Bacteriologist did lumbar puncture, but spinal fluid appeared normal, no excessive flow and no turbidity. Blood from arm taken. Thirty cubic centimetres Burroughs Wellcome serum given intravenously.

March 21, 1916: Condition much same, more cyanosis of face. Patient says he feels more comfortable, seems to move his limbs more easily and with less pain. Vomits all fluids given by mouth.

In afternoon patient became much more restless, respiration becoming quicker and weaker, cardiac sounds very rapid and also weak. Patient died 6.15 p.m. No post-mortem was made.

(*Signed*) F. C. DAVIDSON,
Captain, R.A.M.C.

Bacteriological Report.

Lumbar puncture (at 10.15 a.m., March 20, 1916).

Cerebrospinal fluid was quite normal in appearance. The pressure was not above the normal. Twenty cubic centimetres of cerebrospinal fluid removed.

Ten cubic centimetres centrifuged for five minutes showed no deposit to the naked eye. Microscopical examination was negative.

Cultures made from the original fluid and from the same fluid after twenty-four hours' incubation remained sterile.

Blood culture (at 10.30 a.m., March 20, 1916):—

Two tubes of bullock heart trypsin broth were inoculated each with one cubic centimetre of blood from patient's arm.

Another two cubic centimetres of blood was put by itself into a sterile tube which contained a few drops of citrate solution.

At the end of thirty-six hours diplococci could be seen in both broth tubes, and also in the tube which contained blood only.

On subculture pure growths of a typical meningococcus were obtained from all three tubes.

Blood films (taken at 2.15 p.m., March 20, 1916), showed a very marked polymorphonuclear leucocytosis.

After searching the film for about five minutes a polymorphonuclear leucocyte was found containing twelve typical diplococci. A further search showed other polymorphonuclear leucocytes containing diplococci. In all nine such leucocytes were found in a quarter of an hour. These leucocytes all contained four or more diplococci. No free diplococci were seen. The diplococci varied a good deal in size and in the depth of staining. The shape was exactly typical of the meningococcus. They were Gram-negative.

Films made from blood which had been incubated with a few drops of citrate solution for thirty-six hours showed this same diplococcus in very large numbers. Nine or ten diplococci could be seen in nearly every field, in a thin film, with the $\frac{1}{12}$ inch lens. Very many of the polymorphonuclear leucocytes now contained diplococci. In one I counted more than seventy.

A small grey and white rabbit, just over three months old, was inoculated intraperitoneally, with one cubic centimetre of the above incubated blood. The rabbit, forty-eight hours later, seemed to be very ill, was breathing quickly, and refused food. Next day it was better. It has now recovered. Blood films taken daily have been negative.

N.B.—Subcultures from the blood of both the above cases were submitted to Captain A. W. M. Ellis, R.A.M.C., of (Canadian) Mobile Laboratory, on March 23, 1916.

Captain Ellis reports that both are typical meningococci. He classes them both as Type II.

(*Signed*) A. C. H. Gray,
Major, R.A.M.C.

These cases resemble one another remarkably. The first case has no history, but in the others there is a malaise, not severe enough altogether to prevent duty, lasting from three to seven days. This is followed by a severe illness fatal within four days, whose chief symptoms are :—

(1) Fever, not always present on admission, rising to 104° or 105° before death.

(2) Rapid and small pulse.

(3) Rapid respiration, sometimes with signs of œdema of the lungs.

(4) Delirium or coma.

(5) General pains. In Case 4 there was a great deal of tenderness, and movement of the limbs caused much pain. There is not the neck and back stiffness, nor the Kernig's sign characteristic of cerebrospinal meningitis.

(6) A profuse purpuric rash, with large blotches on the limbs and smaller on the face and trunk. It appeared as far as could be judged on the second day of the severe illness.

(7) The cerebrospinal fluid is not under high pressure, is clear, and is sterile. (Staphylococcus in Case 2 is probably a contamination.)

(8) The blood examined as a film shows diplococci which on cultivation give the usual reactions of meningococcus. In our cases the coccus has been of the Type II (common to both Ellis and Gordon).

(9) Autopsy shows a few petechiæ in the heart, which are common in any septicæmia, and a striking petechial rash in the stomach, which is not.

A separate paper by Captains Ellis and Kaye will give references to the literature written on these and other unusual cases of meningococcal infection.

(*Signed*) W. P. HERRINGHAM,
Colonel, A.M.S.

ADDENDUM TO PAPER ON MENINGOCOCCAL SEPTICÆMIA.

Two Cases by Lieutenant R. Thornley, R.A.M.C., with Note by Colonel Herringham.

Since forwarding the above paper I have received the following notes from Lieutenant Thornley.

Case 5.—*No clinical history. Death in twenty-four hours. Autopsy. 2nd Lieutenant, aged* 20.

Seen by resident medical officer on morning of March 31; only complaint, sore throat; no temperature recorded; died within twenty-four hours (only history obtained by me).

Post-mortem performed 12 mid-day, April 2.

Intense post-mortem staining (?) of whole body, but very marked over chest and abdomen, with exudation of blood-stained fluid from mouth.

Lungs very congested; right upper lobe and apex adherent to pleura (old adhesion).

Heart normal.

Liver congested, and on section showed peculiar honeycomb appearance due to formation of small gas bubbles (? glucose fermentation).

Spleen much enlarged, friable, and congested.

Kidneys engorged; otherwise normal.

Tonsils and throat very dark and engorged.

Brain normal in appearance, and no excess of fluid at base or in spinal canal, but on section some turbidity of fluid with flakes of lymph in fourth ventricle.

Pure culture of meningococcus obtained from each tonsil, heart blood, spleen, liver, fourth ventricle, and base of brain.

Case 6.—*Sore throat. Delirium. Death in forty-eight hours. Civilian Frenchman, aged* 16.

Taken ill morning of April 20. Complained of sore throat; an hour later, worse, so went to bed but refused to see a doctor. On 21st, much worse, so employer sent for garrison medical officer, who saw him at 10 a.m. Temperature not recorded; was delirious, extremely ill, and found dead in bed about 3 p.m.

Post-mortem performed mid-day, April 22.

Intense post-mortem staining (?) of body, most marked over abdomen.

Heart normal.

Lungs very congested.

Liver congested and dripping blood freely.

Spleen enlarged and very friable.

Kidneys congested.

Brain normal, no pus or excess fluid.

Pure cultivations of meningococcus isolated from heart, liver, spleen, kidney, and fourth ventricle.

(*Signed*) R. THORNLEY,
Lieutenant, R.A.M.C.

These two cases complete the post-mortem account, which was not so fully recorded in the other four.

They show even more strikingly the virulence of the infection, and also the existence of cerebral infection as a part of the general septicæmia.

Especially curious is the gas formation in the liver, for which Lieutenant Thornley suggests an explanation founded on the power of the meningococcus to ferment glucose.

(*Signed*) W. P. HERRINGHAM,
Colonel, A.M.S., Consulting Physician.

Clinical and other Notes.

OBSERVATIONS ON THE PATHOGENICITY AND SPECIFIC CHARACTERS OF THE *BACILLUS FÆCALIS ALKALIGENES.*

By Captain L. F. HIRST.

Royal Army Medical Corps.
Pathologist to No. — General Hospital, Egypt.

The *Bacillus fæcalis alkaligenes* was described by Petruschky for the first time in 1889 as an organism resembling *Bacillus typhosus*, which he isolated from a specimen of stale beer and human fæces. At first regarded as a harmless saprophyte, the organism was later considered by its discoverer to be the causative agent of a typhoid-like illness in man. In recent years a few cases of this nature have been described by various observers. A paper containing a summary of the literature on this subject by Lieutenant-Colonel Ledingham has recently appeared.

The paper by Captain Shearman, my predecessor at No. — General Hospital, and Captain Moorhead, our late Consulting Physician, describes eleven cases of bacillæmia associated with a mild disease of the enterica type.

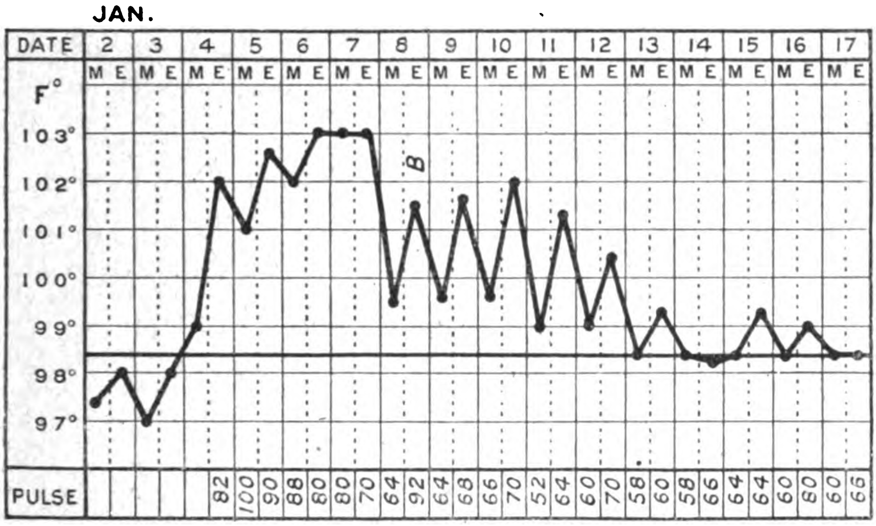
My attention was first directed to the question of the pathogenicity of *B. fæcalis alkaligenes* while working on enteric carriers at the Military Laboratory, Alexandria, in 1916. I was surprised at the frequency with which this organism is found in the stools of convalescent cases of enteric in Egypt. On taking over from Captain Shearman, I learnt that he had isolated the organism from the blood of a series of cases at No. — General Hospital. Subsequently I also have succeeded in isolating *B. fæcalis alkaligenes* in a pure culture from the blood of a further series of twelve cases.

During the year 1916, 622 blood cultures have been bacteriologically examined at this hospital. *B. fæcalis alkaligenes* has been isolated no less than 23 times out of a total of 123 positive cultures, i.e., 18·7 per cent. Included in 123 are 12 pure cultures of *B. coli*. The remaining 88 are organisms of the enterica group *B. typhosus* and *paratyphoid* A and B.

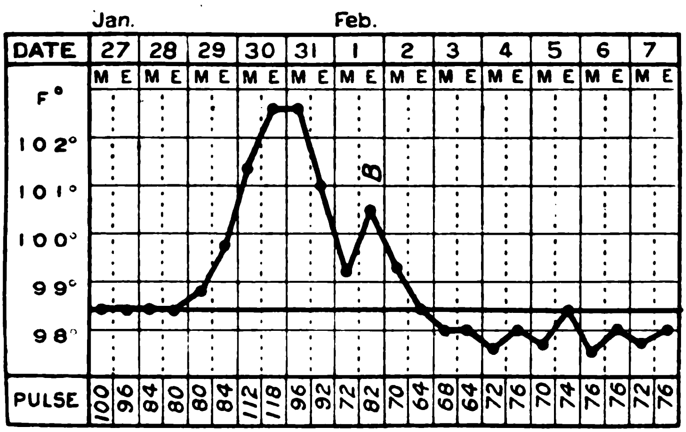
The seasonal distribution of these cases for the year 1916 was as follows: March, 1; May, 9; June, 5; September, 4; October, 2; November, 1; December, 1.

A detailed description of the clinical features of my cases does not fall within the scope of this paper. Captain H. F. Blood, who has observed most of these cases, informs me that the clinical picture is briefly as follows:—

Onset sudden, evening rise of temperature for about five days, marked remission, but morning temperature not falling quite to normal, then a brief intermission followed by more irregular pyrexia for a few more days. The patient's aspect is pale, and he has a toxic appearance out of propor-



CASE 9.—B = Blood culture taken.



CASE 11.—B = Blood culture taken.

tion to his symptoms, which are usually indefinite. The tongue is coated with a brownish fur, red at edges and moist. The pulse is slow in proportion to the temperature. There are no spots and the spleen is not enlarged.

Captain T. G. Moorhead's cases reported in the already mentioned paper evidently were very similar, but the intermission in the temperature appears to have been much more pronounced than in our cases.

Clinically, Cases 2, 3, 4, 7 and 8 correspond closely to Captain Blood's description of a typical *B. fæcalis alkaligenes* infection.

In Cases 1, 4, 5 and 8 the course of the infection was much influenced by the complications noted in Table I. The duration of the pyrexial period of Case 5 was abnormally long, but this case was diagnosed on clinical grounds as *B. fæcalis alkaligenes* infection before I isolated the organism from the blood.

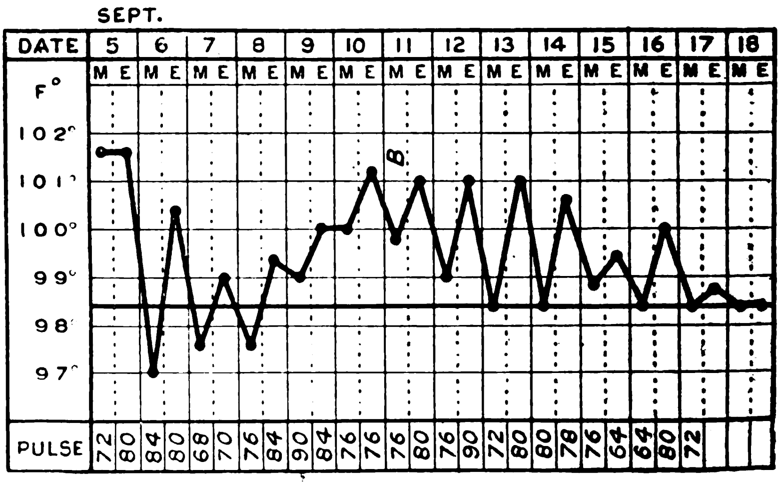
Cases 10, 11 and 12 were all blood cultured on account of a suspicion of *B. fæcalis alkaligenes* infection.

There can be no doubt that *B. fæcalis alkaligenes* bacillæmia is associated with definite and distinct clinical signs, though whether this affection can be clearly distinguished clinically from certain varieties of *B. coli* bacillæmia is yet undecided.

The main facts of pathological interest in connexion with these cases are shown in Table I.

Notes on Three Additional Cases of Systemic Infection by *B. fæcalis alkaligenes*.

Captain H. Wiltshire has recently isolated *B. fæcalis alkaligenes* from the blood of three cases under treatment at another General Hospital in Alexandria. The bacteriological observations were made at the Military Laboratory, Alexandria.



CASE 3.—B = Blood culture taken.

All three were cases with a low irregular pyrexia of short duration with symptoms similar to those already described. They were blood cultured on account of a suspicion of enterica.

Case 1.—Aged 34, T.V. 2, September, 1914. Patient's serum agglutinated the homologous strain of *B. fæcalis alkaligenes* up to a dilution of 1 in 50. His pyrexia began after nine days' treatment in hospital for a surgical affection of the feet.

Case 2.—Aged 29, T.V. 2, September, 1915. Admitted on account of a staphylococcic abscess of the leg. Pyrexia persisted without apparent cause after abscess was treated. Widal reaction negative to T.A.B.

Case 3.—Aged 38, T.V. 2, September, 1915. Admitted on account of "headache." His serum agglutinated *B. typhosus* up to a dilution of 1 in 200. *B. paratyphoid* A and B negative.

There was apparently no direct association with inflammatory infection of the bowel in these cases.

Characters of the various Strains of *B. fæcalis alkaligenes*.

Petruschky's original description was written before introduction of modern methods of differentiating bacterial species. The specific name of *B. fæcalis alkaligenes* was subsequently given by various observers to a number of organisms, some of which are clearly distinct species.

Berghaus compared a number of strains from various sources. He found that the pure cultures agreed generally with Petruschky's original description, save that the flagellæ were polar and not peritrichal. He came to the conclusion that *B. fæcalis alkaligenes* was a pure saprophyte, and identified it with *B. fluorescens non-liquefaciens* and *B. fluorescens putidus* (Flügge) which had lost the power of producing a fluorescent pigment.

Much confusion has been caused by working on impure cultures of *B. fæcalis alkaligenes.*

Klimenko in 1907 collected fifteen strains designated *B. fæcalis alkaligenes* from various laboratories in Russia and Germany and carefully compared them with seven strains of his own, isolated from a water supply in Petrograd, and with strains of *B. fluorescens non-liquefaciens* and *B. fluorescens putidus*.

He shows clearly that these latter organisms are saprophytes with an optimum temperature of 20° C., and having distinct characters from *B. fæcalis alkaligenes*. Four of this collection of laboratory strains turned out to be identical with these saprophytes.

Several of Klimenko's strains formed acid with glycerine, lævulose, and galactose. The organisms in Klimenko's sub-group I. of *B. fæcalis alkaligenes* include two of Petruschky's strains. The various organisms could be split up into a number of sub-groups by their action on carbohydrates, and by the use of agglutinating sera prepared by injection o typical strains into animals.

I have carefully compared the descriptions given in such literature as I could find in Alexandria of strains isolated by various observers with the characters of my own strains isolated by hæmoculture, and from the urine and fæces of patients in No. — General Hospital.

Table II. shows the principal characters given by these observers contrasted with those of my principal group of blood strains. Petruschky's strains No. 1 and 2, as described by Klimenko, may be regarded as the type species of *B. fæcalis alkaligenes.*

Some of the difference in these descriptions, such as the arrangement of the flagellæ, the liquefaction of gelatine and the action on carbohydrates are of specific importance. Castellani's organism is quite distinct from the type species.

The strains isolated from human blood in Alexandria differ from those previously isolated by hæmoculture by Rochaix and Marotte, and by Straub and Krais mainly in respect of their lower agglutinability to the patient's serum and their more variable motility.

Strain 2 of Straub and Krais closely agreed with the laboratory strain of *B. fæcalis alkaligenes* (Schottmüller) with which it was compared.

The strain from the pleural effusion of Case No. 8 was isolated by Captain J. G. Thomson. I am responsible for the isolation of all the other strains isolated at No. — General Hospital since September 1, 1916.

My twelve strains isolated by hæmoculture fall into two groups, the first comprising the bacilli isolated from the first nine, and the second from the last three cases. No appreciable difference could be detected between the individual members of either group.

Each organism before testing its characters was replated to ensure purity.

Group I.—Morphology.

All the nine strains were pleomorphic, especially after repeated subculture on agar. For example, the strain of Case 8 showed only short and coccoid forms and was non-motile when first isolated, but became actively motile with long filaments by the sixth sub-culture on agar, the biochemical characters remaining the same as before.

I am indebted to Captain J. G. Thomson for the following measurements from a film from a twenty-four hours' culture on agar. Length: maximum, 4 microns; minimum, 1·5 microns; average about 2·5 microns. Breadth: maximum, 1 micron; minimum, 0·5 micron; average about 0·75 micron. The organism thus shows long and coccoid forms. It is broader than *B. typhosus*. It is rounded at the ends. It sometimes grows end to end in long chains.

Klimenko's strains were mostly short thick bacilli with rounded ends. He describes a type with long motile filaments and sharp cut ends.

All the strains of Group I were non-motile in the primary culture.

Strain 8 became actively motile on sub-culture and several of the others sluggishly motile.

All the strains showed flagellæ when stained by the method of Nicolle and Morax, the typical arrangement being two at each end, but sometimes there is a leash of six flagellæ at the end. This agrees closely with the type species.

Staining.—Most of the strains show Neisser granules in the protoplasm of a large proportion of the bacilli, but this is not a constant character. There are no spores. None of my strains stained by Gram's method. No growth took place in one week in broth cultures incubated anaerobically. No indol was found in peptone broth after one week's incubation at 37° C. None of the strains liquefied gelatine in one month. There was no sign of clarification of milk after one month at 37° C. (six strains).

Effect on Carbohydrates.—No acid nor gas was formed by any strain in lactose, glucose, saccharose, maltose, mannite, dulcite, and dextrine; one per cent peptone broth. Four strains tested with galactose, arabinose, lævulose, and glycerine, also proved negative. There was usually marked alkali production in these media.

Growth in Bouillon.—A marked pellicle was usually formed rapidly. The pellicle formation is especially rapid in broth containing carbohydrates. A somewhat granular deposit formed at the bottom of the tube.

Reducing Power.—The colour of neutral red (Grübler) was rapidly changed to light yellow on MacConkey's medium containing glucose or lactose. Neutral red peptone water showed only the usual alkaline change. Some of the strains reduced the colour of litmus after prolonged incubation in litmus tinctured media.

Pigment Formation.—The growth on potato was light brown. The growth on old agar cultures sometimes became slightly brownish. There was never any colouration of the medium.

Pathogenicity.—Emulsions in salt solutions of a few loopfuls of two recently isolated strains were injected intraperitoneally into guinea-pigs without producing any visible effect on the health of the animals.

Specific Agglutination Test.—The macroscopic method was used in a few observations of this kind made. It is often difficult to prepare a suitable emulsion of the organism. On the whole it would appear that the agglutination test is not of much value in the diagnosis of the Near Eastern strain of *B. fæcalis alkaligenes.*

Group II.—Hæmoculture Strains.

This group isolated from similar cases gives similar reactions to the tests applied. Morphologically the strains were coccoid with only a few bacillary forms. I did not succeed in demonstrating flagellæ. No motility developed after repeated sub-culture in young cultures. Litmus

was more rapidly reduced and neutral red more rapidly decolorized than by the first group. Milk showed distinct clarification after fourteen days. These strains had the other characters of the first group.

Strains from Fæces and Urine.—These closely conformed to Group I, but many strains were actively motile when first isolated. Several strains gave a viscous pellicle on broth. Six strains only were put through all the above tests. Usually I think it sufficient to identify an organism as *B. fæcalis alkaligenes* to apply the following tests: Motility in hanging drop, Gram's stain with counter stain, litmus milk, gelatine, agar slope, peptone bouillon and lactose, and glucose one per cent litmus peptone water. The use of the agar slope avoids confusion with *B, pyocyaneus* and other pigment producers.

The discrete colonies on MacConkey's lactose bile salt agar are fairly characteristic, being large, transparent, with irregular edge and surface, and surrounded by a marked zone of yellow.

There is a fairly close agreement between the characters of most of my strains and Klimenko's Sub-group I. They are almost certainly the same species. Three strains isolated from Cases 10, 11, and 12, possibly belong to a distinct species.

Most of the organisms in my series were isolated by means of a technique and culture medium similar to that employed by Captain Shearman. Since November, owing to difficulties in obtaining suitable ingredients for this medium, a modified MacConkey's medium was used with beef broth as a base, and azolitmin as an indicator, our stock of Grübler's neutral red being almost exhausted.

The blue colonies of *B. fæcalis alkaligenes* show up well on such a medium, if they are sufficiently discrete from the *B. coli.*

Most of the fæcal strains were isolated on this medium. If a special search for *B. fæcalis alkaligenes* is being made, it is best to include all the principal carbohydrates in the same medium, instead of using only lactose.

Pathogenicity of *B. fæcalis alkaligenes* to Man.

In addition to the question whether the term *B. fæcalis alkaligenes* is being applied to a single variable species or to a group of closely related species, the question also arises as to whether *B. fæcalis alkaligenes* is a true pathogenic organism or only a secondary invader from the bowel.

It is now well established that intestinal *B. coli* do not invade the system through healthy mucous membrane, but are not uncommon as secondary causes of bacillæmia in cases of dysentery, enterica, and other inflammatory conditions of the coat of the intestine.

B. coli bacillæmia is well known all over Europe. As already mentioned we have records of twelve cases during 1916 at this hospital.

With a view to shedding more light on the question, I have carefully examined 100 consecutive stools of enteric convalescent and dysentery patients received in the laboratory since November 25, 1916, and also the stools of fifty patients in the general wards and venereal compound who gave no definite history of diarrhœa, enterica or dysentery during the two months before admission. They all received a preliminary purge before taking a sample. The results are as follows:—

Abnormal stools	Total	*B. fæcalis alkaligenes* found
Enteric convalescents	43 ..	16
Dysentery convalescents	57 ..	29
Normal stools	50 ..	*Nil*

The colonies of *B. fæcalis alkaligenes* when present, were often very numerous.

The *B. paratyphosus* A was found also in one of the convalescent enterica stools. Two *B. dysenteriæ* (Flexner) and one *B. dysenteriæ* (Shiga) were isolated from the dysentery stools.

This result is very striking and strongly suggests to my mind that *B. fæcalis alkaligenes* multiplies in certain abnormal states of the bowel, but is present in small numbers, if at all, in normal individuals in this country.

Nevertheless reference to Table I shows that I have been unable to trace any direct association with bowel complaints in some of the cases.

Cases 1, 6, 8, 10, and 11, exhibit such associations clearly. Various forms of dysentery and diarrhœa are very prevalent in Egypt.

Mild infections with dysentery bacilli may cause very few symptoms and the occasional passage of a small amount of blood and mucus is apt to be disregarded by the men.

I may mention that Captain J. G. Thomson has found that lesions due to *Entamœba histolytica* and other pathogenic protozoa are more frequently present and may cause less obvious symptoms than is generally believed. I understand that isolated amœbic ulcers were commonly found post mortem in the bowels of men killed in action on the Gallipoli Peninsula, who had not reported sick. The normal cases were all examined quite recently, when the dysentery season was practically over.

My own view is that *B. fæcalis alkaligenes* is an organism of low virulence to man, perhaps commoner here than in most other localities, which is capable of multiplying in the bowel in certain favourable conditions, and occasionally gains access to the blood-stream through a more or less damaged mucous membrane, thereby producing a mild enteric-like infection.

B. fæcalis alkaligenes may be regarded as intermediate in its pathogenicity to man between the *B. coli* group and the true enterica group

TABLE I.

Case number	Probably infected in	Leading features	Complications	Association with dysentery and enteric	Laboratory findings	Inoculations
(1) Serjt. P., aged 25	Sidi-Bishr Camp	Mixed infection. *B. typhosus* and *B. fæcalis alkaligenes*. Commenced as ordinary attack of typhoid. In hospital from 8.7.16 to 18.11.16 (dated invalided to England). *B. fæcalis alkaligenes* attack fifteen days, 8.9.16 to 23.9.16	Typhoid pyonephrosis. Operations: Nephrotomy and nephrectomy. Left kidney 27.8.16 and 29.9.16	Ten days after second operation *B. fæcalis alkaligenes* attack commenced	11.7.16. *B. typhosus*, blood 27.8.16. *B. fæcalis alkaligenes*, urine 27.8.16. *B. typhosus* pus from pyonephrosis 16.10.16. *B. fæcalis alkaligenes*, blood	T.A.B. / 2
(2) Cpl. E., aged 24	Sidi-Bishr Camp	Irregular pyrexia eighteen days, 25.8.16 to 13.9.16. Typical case clinically	Erythema nodosum right leg	Nothing definite. Epidemic of dysentery at Sidi-Bishr Camp	10.9.16. *B. fæcalis alkaligenes*, blood	T.A.B. / 2 May, 1915
(3) Trpr. C., aged 22	No. 3 Aust. Genl. Hosp.	Irregular pyrexia fifteen days, 1.9.16 to 16.9.16. Fairly typical case clinically	*Nil*	Attack of diarrhœa preceded *B. fæcalis alkaligenes* attack	5.9.16. No malarial parasites, film 11.9.16. *B. fæcalis alkaligenes*, blood 11.9.16. Negative to *B. fæcalis alkaligenes* 1/25 Widal	T.A.B. / 2 July, 1916
(4) Drvr. P., aged 22	Salonika	Irregular pyrexia seven days, 15.9.16 to 22.9.16. Did not re-act properly to quinine. 18.9.16 to 24.9.16	Benign tertian malaria	No history of dysentery or enteric	19.9.16. Benign tertian parasites, film 21.9.16. *B. fæcalis alkaligenes*, blood	T.A.B. / 2
(5) Pte. F., aged 26	Sidi-Bishr	Pyrexia six days. Complications insufficiently acute to explain temperature	Gonorrhœal epididymitis. Malaria ?	No history of dysentery or enteric	23.9.16. *B. fæcalis alkaligenes*, blood 28.9.16. *B. fæcalis alkaligenes*, stool 30.9.16. *B. fæcalis alkaligenes*, stool	T.A.B. / 2 Jan., 1916
(6) Pte. B., aged 25	India	Irregular pyrexia forty days, 5.10.16 to 14.11.16	*Nil*	History of chronic dyspepsia	22.10.16. *B. fæcalis alkaligenes*, blood	T. / 2
(7) Gnr. B., aged 21	Salonika	Irregular pyrexia thirty-six days, 3.10.16 to 8.11.16. Quinine no effect on temperature. Spleen not enlarged. Clinically typical	*Nil*	*B. fæcalis alkaligenes* attack possibly preceded by *B. paratyphoid* A infection	4.11.6. *B. fæcalis alkaligenes*, blood 7.11.16. No malarial parasites. No protozoa in stools Two negative Widals T.A.B. at Salonika	T.V. / 2 Feb., 1915
(8) Drvr. T., aged 21	Salonika	Irregular pyrexia thirty-one days, 1.11.16 to 1.12.16. Probably began illness with *B. typhosus* infection, followed by *B. fæcalis alkaligenes* attack	Pleurisy with effusion. Benign tertian malarial parasites found at Salonika	No history of dysentery	9.11.16. *B. typhosus* positive. 1/800 Widal 25.11.16. *B. fæcalis alkaligenes*, pleural effusion 28.11.16. *B. fæcalis alkaligenes*, blood 28.11.16. *B. typhosus* positive. 1/200 Widal. *B. fæcalis alkaligenes* negative 1/25 6.12.16. *B. fæcalis alkaligenes*, fæces 10.1.17. *B. fæcalis alkaligenes*, negative 1/25 Widal	T.V. / 2 Sept., 1914

(9) Rflmn. S., aged 47	Alexandria	Irregular pyrexia eleven days, 4.1.17 to 15.1.17. Clinically typical of *B. fæcalis alkaligenes* infection	Stricture of urethra, 10.12.16	No previous history of enterica or dysentery	7.1.17. No malarial parasites 8.1.17. *B. fæcalis alkaligenes*, blood 9.1.17. Typhoid 1/50 Widal 22.1.17. *B. fæcalis alkaligenes*, positive. 1/50 Widal. Three strains of *B. fæcalis alkaligenes* 15.1.17. *B. pyocyaneus*, urine 25.1.17. *B. pyocyaneus* and *B. fæcalis alkaligenes*, stool	T.V. India
(10) Capt. H., R.A.M.C., aged 41	Alexandria	Pyrexia four days, 25.1.17 to 28.1.17. Sudden onset with rigor. Dysentery second day	Bacillary dysentery	Contracted dysentery on Peninsula in August, 1915. Invalided home. Several relapses subsequently	*B. dysenteriæ* (Flexner) isolated in England 25.1.17. No malarial parasites. 26.1.17. *B. dysenteriæ* stool (Flexner typical) 28.1.17. *B. fæcalis alkaligenes*, blood 29.1.17. Widal negative 1/50 T.A.B. and *B. fæcalis alkaligenes*, two strains. No amœbæ found 16.2.17. *B. fæcalis alkaligenes* positive 1/50 Widal. Homologous strain	T. 1911 No T.A.B.
(11) Pte. G.	Alexandria	Pyrexia five days, 29.1.17 to 2.2.17. Sudden onset with rigor. Laboratory orderly	*Nil. B. fæcalis alkaligenes* infection during convalescence from attack of dysentery	Contracted dysentery March, 1915. Several relapses subsequently. Admitted hospital with dysentery 22.1.17	28.1.17. No dysentery bacilli isolated, stool 1.2.17. *B. fæcalis alkaligenes*, blood 30.1.17. No malarial parasites	T.A.B. 1916
(12) Gnr. H., aged 32	India	Pyrexia four days after admission, 31.1.17 to 3.2.17. Sudden onset	Said to be convalescent from malaria	No history of dysentery	No malarial parasites found in India 1.2.17. No malarial parasites seen 2.2.17. *B. fæcalis alkaligenes*, blood. Widal *B. typhosus* positive 1/50. Para. A and B negative 1/50. *B. fæcalis alkaligenes* negative 1/50	—

Case 4 was the only one giving a marked diazo reaction.

The spleen could be felt in Cases 4 and 5. The enlargement in Case 4 was clearly due to malaria and possibly in Case 5 also.

Case 1 has the very unusual complication of a pyonephrosis due to the *B. typhosus*. It is likely that the patient had a hydronephrosis before his illness, which became infected with *B. typhosus* in the bacillæmia stage of this infection. The specific organism was isolated on pure culture from the pus of the nephrotomy wound.

The *B. pyocyaneus* was isolated from the urine and fæces of Case 9.

Many cases of bacillæmia due to this organism have been reported from tropicalcountries, where it is often omnipresent.

B. pyocyaneus has been shown to be only capable of invading the system through damaged mucous membrane.

Cases 11 and 12 were in hospital together. Clinically they resembled one another very closely. The symptoms were similar to the earlier cases, but the pyrexial period was very short. No connexion between them could be traced. As will appear later, the organisms isolated from the blood had exactly similar characters and differed distinctly from the other nine strains.

of bacteria. Both clinically and pathogenically *B. fæcalis alkaligenes* infections seem more nearly related to disease conditions due to the coli group of organisms than to the true enterica group. *B. fæcalis alkaligenes* infection seems widely distributed in Egypt. Captain Wilmore tells me that he has recently discovered several cases of *B. fæcalis alkaligenes* bacillæmia at Suez.

B. fæcalis alkaligenes has been isolated from dust and from contaminated water supplies by several bacteriologists in Egypt. This is only natural in view of its great prevalence in diarrhœal stools in this country. As an indication of pollution of a water supply, I would attach more significance to its presence than to ordinary *B. coli*, but its occasional presence in small numbers need not cause alarm.

I agree with Captain Shearman that with the diminution in the incidence of the ordinary enterica infections as the result of inoculation, obscure febrile diseases due to *B. coli*, *B. fæcalis alkaligenes* and *B. pyocyaneus* and their allies, are likely to come into increased prominence as a cause of sickness among troops living under insanitary conditions.

Many cases of this type running a short course must occur which are never admitted to hospitals provided with laboratory facilities.

I am much indebted to Captain H. Wiltshire for the notes on his cases, and to Captain J. G. Thomson, R.A.M.C., for assistance in the preparation of the paper, and also to the medical officers in charge of the wards in the Hospital, particularly Captains Blood and Bradley, for procuring specimens and clinical notes, and to Colonel Sandwith and Dr. Grendiroupolo for kind help in getting together the available literature.

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TABLE II.

Authors :	Petruschky	Klimenko. (Sub-Group I)	Straubo Krais. (Strain 1)	Straubo Krais. (Strain 2)	Rochaix and Marotte	Castellani	Shearman	Hirst
MOTILITY—	+	Variable	++	++	++	+	Variable	Variable.
FLAGELLÆ—	Peritrichal	Polar	Polar	Polar	—	—	—	Polar.
GELATINE—	Not liquefied	Not liquefied	Liquefied	Not liquefied	Not liquefied	Not liquefied	Not liquefied	Not liquefied.
BOUILLON —	Turbid	General turbidity, pellicle deposit	Floccali pellicle	General turbidity, pellicle	General turbidity, pellicle	General turbidity	Turbidity slight, pellicle deposit	General turbidity, pellicle deposit.
CARBOHYDRATES—	Not fermented	Not fermented	Not fermented	Not fermented	Not fermented	Acid in mannite, glucose and dextrose inosite	Not fermented	Not fermented.
LITMUS MILK—	Very blue	Blue	Blue	Blue	Very blue	Blue	Blue	Blue.
MILK—	—	Slow clarification	Clarification	Clarification	Clarification	—	Occasionally peptonized	No clarification, 6 strains after three weeks.
INDOL—	Negative	Negative	Negativo	Negative	Negative	Negative	Negative	Negative.
PIGMENTATION—	Browning of potato	Light brown on potato	*Nil*	*Nil*	—	—	—	Brown on potato, browning of old agar cultures.
PATHOGENICITY, INTRAPERITONEAL INJECTION—	For guinea pigs	Not pathogenic to guinea-pigs, white mice and rats	Not for guinea-pigs or mice	—	—	—	—	Not for guinea pigs.
AGGLUTINATION BY PATIENT'S SERUM—	—	—	To 1 : 1,000	To 1 : 1,000	To 1 : 1,000, 1 : 2,000	—	To 1 : 200	To 1 : 50.
REMARKS —	From description given in Flügge's Text-book	Characters of seven strains from various sources including Petruschky I and II	Strain isolated from blood of a case giving history of dysentery followed by irregular pyrexia	Strain isolated from urine during convalescence of case of irregular pyrexia	Two strains isolated from two cases of benign enteric infection	Characters tabulated in Chalmers and Castellani's Text-book	General characters of 11 strains isolated from blood	General characters of 9 strains isolated from blood.

NOTES ON THE USE OF FLAVINE IN THE TREATMENT OF INFECTED GUNSHOT WOUNDS.

By Major ROBERT B. CARSLAW.
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The following notes are based on observations on twenty-two cases of infected gunshot wounds (with abundant pus formation) treated with Flavine. The reason why so few cases were treated with this antiseptic was that the quantity available was so small (fifteen grammes) that it could be employed in only a few selected cases.

Previous Treatment.

In the majority of the cases treatment with Flavine was commenced within a few hours of the patients' arrival, but in some the wounds had been treated, unsuccessfully, in this hospital for some time by other methods before Flavine was resorted to. The former cases had been treated, before admission, by various methods, e.g., "eusol," salt pack, B.I.P., carbolic acid; in the latter cases "eusol," carbolic acid, perchloride of mercury, or iodoform gauze had been employed.

Method of Application.

In every case care was taken to obtain an "open" wound with adequate drainage, and any accessible "foreign body" (metal, cloth, loose bone) was removed. The solution used was one part of Flavine in 1,000 parts of physiological saline.

Strips of gauze well soaked in this solution were lightly packed into the depths of the wound, which was then covered with folds of gauze similarly soaked, the whole being covered by jaconet.

The folds of gauze were changed once or twice a day, but the packing was as a rule not removed until forty-eight hours after introduction.

In one case a 1 in 2,000 solution was used as in Carrel's procedure.

Progress.

The wounds treated were without exception very septic; there was profuse purulent discharge, and very marked inflammatory reaction was present in the surrounding tissues. In many cases there was extensive sloughing.

At the end of a period which varied from three to seven days the following changes had occurred:—

(*a*) All signs of inflammatory reaction in the surrounding tissues had disappeared. In many cases this change took place within the first three days, even though the other phenomena might be somewhat delayed. The general condition of the patient, as indicated by the temperature, pulse, etc., showed a corresponding improvement, and there was an extraordinary absence of pain.

(*b*) The sloughs had separated: occasionally a few small sloughs remained, although the rest of the wound had become quite clean.

(*c*) The discharge had almost entirely ceased, a marked diminution having taken place within the first forty-eight hours.

(*d*) New formed epithelium was rapidly growing over the granulations.

(*e*) The wound was now covered by a yellowish membrane. Under this and between its edge and the growing epithelium were small, firm, healthy pink granulations.

If the application of Flavine was continued after this stage had been reached no further appreciable changes took place, except that the epithelial growth continued undisturbed. The yellowish membrane remained adherent to the granulations underlying it.

If, however, a moist "eusol" dressing was now applied the membrane rapidly separated, and within two, or at the most three days, the wound showed nothing but bright red granulations which bled readily on being swabbed. In two cases the Flavine dressing was continued for more than a week after the condition above described (yellowish membrane, etc.), had been reached and no appreciable change took place. In both, however, the final stage (bright red granulations) was attained after "eusol" had been applied for two days.

EXCEPTIONS.

In cases in which there was a compound fracture, the purulent discharge continued much longer although in diminishing amount, but the soft tissues showed the changes above described.

In cases of hernia cerebri the sloughs took much longer to separate: in one case this did not take place till the seventeenth day.

BACTERIOLOGICAL EXAMINATION.

In fourteen cases a bacteriological investigation was conducted with a view to ascertaining whether this could give any information regarding the progress of the wound. Cultures were made and films examined, the number of organisms per field being estimated.

In only one case was there a continued reduction in the numbers of bacteria; in the others the numbers either remained approximately constant or there was an actual increase in the number of one or other of the bacteria present.

In two cases an examination (cultures and films) was made of the yellowish membrane and of the granulations underlying it. No difference in the numbers or character of the bacteria in these two situations was found.

The membrane itself consisted of an amorphous coagulum in which were a fair number of leucocytes, some of which were degenerated, but some of which showed active phagocytosis.

Cases of Gas Gangrene.

It was hoped that the efficacy of Flavine in cases of gas gangrene might have been tested, but in this period only two such cases occurred. Although both these patients died within a few hours of the application the results were suggestive. In the first, a gunshot wound of the upper third of the thigh, a very rapidly extending gas gangrene developed, and disarticulation at the hip-joint was performed. The stump was very œdematous and infiltrated with gas, and it was found impossible to remove all the affected muscle. Twenty cubic centimetres of a 1 in 1,000 solution of Flavine were therefore injected into the affected tissues, a Flavine dressing being applied to the wound. The patient died two hours later. At the post-mortem, which took place fifteen hours later, the gaseous infiltration of the stump had entirely disappeared, although cultures and films from the upper end of the amputated limb showed *Bacillus œdematis maligni* and *streptococci*.

The second case was one of multiple bomb wounds in which gas gangrene developed in the right leg. Free incisions having been made and large pieces of affected muscle having been removed, twenty cubic centimetres of a 1 in 1000 solution of Flavine were injected into the tissues round the wound. The patient died three hours later.

Films and cultures made from the affected muscles at the operation showed *Bacillus perfringens*, but at the post-mortem, which took place twenty-three hours later, cultures from the operation wound yielded only staphylococci and diplococci, although gas was still present, and cultures from the œdematous tissues above the wound (into which Flavine had been injected) yielded no growth of any kind.

Detailed Description of Two Typical Cases.

As illustrating the important features already described, two cases are described in detail:—

Case 2.—Bdr. B., *wounded* on May 15, 1917, *admitted* to No. — General Hospital on May 17, 1917, the wounds having been treated in a C.C.S. by salt packs. Condition on admission was extremely bad; temperature 102° F., pulse 150, and thready. The wounds were: (*a*) Superficial scalp wound; (*b*) circular wound of right forearm about four inches in diameter with destruction of skin and muscles, exposing, but not involving, the radius; there was profuse stinking discharge with very marked œdema of the whole forearm; (*c*) extensive lacerated wounds of the right buttock, one leading down beneath the gluteus maximus to the tuber ischii (which was fractured), another between the gluteus maximus and medius, and another through the gluteus medius and minimus: from these wounds there was profuse stinking discharge; (*d*) an oblique compound fracture of the left tibia from which there was some purulent discharge; (*e*) a wound exposing the left ankle-joint and destroying the

extensor longus digitorum tendons from which there was some purulent discharge. May 17, 1917: Within a few hours of the patient's admission the wounds were treated with Flavine. May 18, 1917: All dressings changed under gas anæsthesia. May 19, 1917: All dressings changed under gas anæsthesia; the inflammatory œdema round the wounds of forearm and buttock had greatly diminished and from these wounds sloughs were already beginning to separate; the patient's general condition had improved (temperature 103° F., pulse 104), and there was a complete absence of pain in these wounds: the wounds of the leg and ankle showed less improvement and were very painful. May 24, 1917: The inflammatory œdema round the wounds of forearm and buttock had entirely disappeared; all the sloughs had separated, the discharge had almost ceased and the wounds were covered with a yellowish membrane. The wounds of the leg were almost as clean but there was still considerable purulent discharge. (Treatment with Flavine was continued as it had not yet been realized that a change should be made when this stage was reached.) June 1, 1917: No appreciable change having taken place since the last note moist "eusol" dressings were now applied. June 3, 1917: The forearm and buttock wounds were now covered with bright red granulations: although the wounds of the soft tissues of the leg were in a similar condition there was still considerable purulent discharge. June 7, 1917: An increase in the inflammation of the leg had taken place: there was once more œdema and pain with temperature 104° F., pulse 124; these wounds were, therefore, opened up more freely and Flavine again applied to them. June 11, 1917: The leg wounds have again improved, the œdema having entirely disappeared. June 18, 1917: Flavine dressings having been continued these wounds, although clean, are still covered by the yellowish membrane; moist "eusol" dressings were now applied. June 20, 1917: The leg wounds were now covered with bright red granulations.

[N.B.—This case illustrates the efficacy of Flavine in the treatment of foul wounds, the futility of continuing the Flavine dressings after a certain stage, and the delay which usually takes place in the presence of a compound fracture.]

Case 15.—Dr. A., *wounded* on June 4, 1917, *admitted* to No. — General Hospital on June 7, 1917, the wounds having been treated in a C.C.S. by B.I.P. and temporary suture. Condition on admission very serious, temperature 102° F., pulse 112. There were very extensive (bomb) wounds of the face and great loss of tissue. There was already considerable sloughing of the skin (the sutures had all cut out) over which purulent discharge was flowing from the depths of the wound; the hard palate was almost entirely separated and was lying on the tongue, the sutures which had suspended it having cut out; the superior maxillary bones on both sides, the nasal bone and cartilages, part of the ethmoid bone, the right malar bone, the floor of the right orbit were all

absent; this deep lacerated wound, which was very septic, was packed with iodoform gauze, the skin wounds being left open; a tracheotomy was performed owing to the difficulty in respiration. June 10, 1917: Under an anæsthetic the iodoform gauze was removed and moist "eusol" dressing applied to the wound which was covered with sloughs and from which there was profuse purulent discharge; this method of dressing was continued for the next three days. June 14, 1917: As the condition of the wounds showed no improvement, and as the patient's general condition was very unsatisfactory, Flavine was now resorted to. June 16, 1917: The patient's general condition had greatly improved, temperature 98° F., pulse 76; the inflammatory condition of the skin and soft tissues were rapidly disappearing and large sloughs were coming away from the depths of the wound. June 18, 1917: Sloughs had all separated, the discharge had almost entirely ceased and the wound was covered with a yellowish membrane; the condition of the skin was perfect. June 19, 1917: Flavine stopped and "eusol" again applied. June 21, 1917: The wounds were now covered with healthy red granulations.

[N.B.—This case illustrates the rapidity with which Flavine can clean up a foul lacerated wound which was not yielding to other methods of treatment.]

Conclusions.

(*a*) Although this series of cases is small the results have been so uniformly satisfactory that one can with confidence affirm that infected lacerated wounds respond much more rapidly to Flavine than to other antiseptics in common use.

(*b*) Browning's statement that Flavine is not only a very powerful bactericidal agent but also is harmless to the tissues and does not in any way hinder the process of repair is borne out by the rapidity with which inflammatory changes in the surrounding tissues disappear, the sloughs separate, healthy granulations appear, epithelium grows over the granulations and by the phagocytic activity of the leucocytes found in the membrane covering these granulations.

(*c*) At the same time it is amply evident that it is not only unnecessary but unwise to use it to the exclusion of other antiseptics.

(*d*) The application of Flavine should be stopped as soon as the sloughs have separated and the wound is covered by the yellowish membrane under which are small, firm, pink granulations. This usually takes place on the fourth or fifth day. A moist "eusol" dressing should now be applied and in two, or at the most three days, the wound will be covered with bright red granulations.

(*e*) In judging of the progress of wounds so treated one must be guided solely by clinical signs and symptoms as no help can be got from bacteriological investigations.

I have to thank Captain D. Campbell, R.A.M.C.(T.F.), for the exceptionally careful notes which he made of the daily progress of the cases, and Lieutenant W. Templeton, R.A.M.C. (T.C), for the bacteriological investigation.

ON THE TREATMENT OF FRACTURES OF LONG BONES.

By Major GORDON TAYLOR.

Royal Army Medical Corps.

Senior Assistant Surgeon, Middlesex Hospital; late Surgical Specialist, Cambridge Hospital, Aldershot, etc.

About a year since, a series of papers was published in the March number of the *Practitioner*, 1916, upon the treatment of fractures in the Aldershot Command [1]. These articles were written by the various surgeons in the several hospitals of the district, and they included an account of the treatment of fractures sustained: (*a*) under conditions somewhat akin to those which obtain in ordinary life, and (*b*) of fractures produced as a result of gunshot injury.

A very fair percentage of the fractures under treatment in the Cambridge Hospital, Aldershot, belonged to the first group, and are derived from the troops training in the use of arms in the district. Inasmuch as these fractures form perhaps the most numerous class of severe injury met with amongst the troops in the Home Commands, their treatment demands very careful attention.

The fractures due to gunshot injury are derived from the Expeditionary Force, and these cases only reach the Aldershot Hospitals a varying number of days after the receipt of their injury. It must be borne in mind, therefore, that the Aldershot experience of gunshot fractures does not refer to a very early phase in their history.

The fractures belonging to the first group have been dealt with according to the ordinary rule of modern surgery, and due regard has been paid to the findings of the British Medical Association Committee on the treatment of simple fractures. We have been influenced in our treatment of simple fractures by the following conclusions of the Committee [2] :—

(1) In cases treated by non-operative methods, the older the patients the worse the result.

(2) In cases treated by immediate operation, the deleterious influence of age upon the functional result is less marked.

(3) In nearly all age groups, the operative cases show a higher percentage of good results than non-operative cases.

(4) Although the functional result may be good with an indifferent anatomical result, yet the most certain way to obtain a good functional result is to secure good anatomical alignment.

(5) Operative measures are not to be regarded as a method to be employed in consequence of failure of non-operative measures, for the results of secondary operations compare very unfavourably with those undertaken immediately after injury; in order to secure the best results from operation, this should be resorted to as soon after the accident as practicable.

(6) The method is not to be undertaken except by such as have skill and experience in surgery, and the surroundings must be such as to ensure absolute asepsis.

In addition, fractures in the neighbourhood of joints and fractures complicated by nerve injuries are almost always submitted to operation.

In a certain number of cases, it has seemed to us obvious from the very first that some form of operative treatment must be adopted to produce good alignment; thus fractures of both bones of the forearm and torsion fractures of the leg bones have almost always been operated upon at a very early date. In a larger series of cases of simple fracture of the long bones, in which good anatomical alignment has not been attained very early by non-operative measures, early recourse is had to operation. A number of late cases of mal-union and non-union have also been operated upon. Sir Arbuthnot Lane's technique has been most rigidly followed.

Cases 1 to 14, and figs. 1 to 25, are examples of simple fractures treated in the Cambridge Hospital. These cases illustrate nothing novel; they are merely specimens of the work done at the hospital to secure the best possible functional result in cases of fracture of the long bones. Special emphasis might perhaps be laid upon the necessity of moving the joints above and below the fracture at a very early date.

Case 1.—*Fracture of Radius and Ulna.* Figs. 1, 2, 3 and 4 are from a case of mal-union of the radius and ulna treated by operation.

Case 2.—*Fracture of Radius and Ulna.* Figs. 5 and 6 are from another case of mal-union of the radius and ulna.

Case 3.—*Fracture of Radius.* Fig. 7 is taken two years after this patient's radius had been plated for mal-union and limited supination. He has now the power of fully pronating and supinating his forearm.

Case 4.—*Fracture of Humerus.* Figs. 8 and 9 are from a patient with a fracture of the surgical neck of the humerus with partial detachment of the great tuberosity. Unsuccessful attempts had been made to get good alignment under anæsthesia by non-operative measures. Operation was performed three weeks after receipt of the injury. The functional result was good.

Case 5.—*Fracture of Femur.* Fig. 10 was taken from a comminuted fracture of the lower end of the femur treated by plating; excellent movement of the knee-joint was obtained.

Case 6.—*Fracture of Leg Bones.* Fig. 11, this man got a good unctional result without operation.

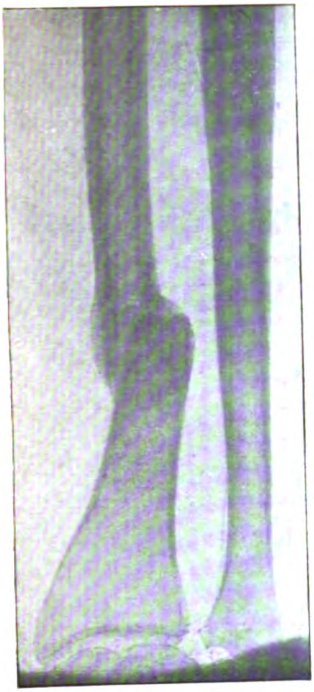

FIG. 1.

FIG. 2.

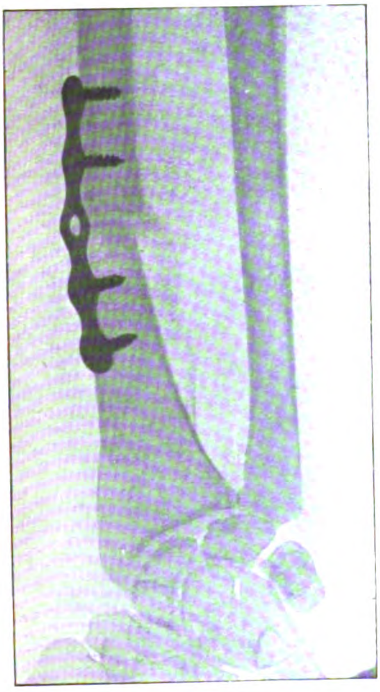

FIG. 3.

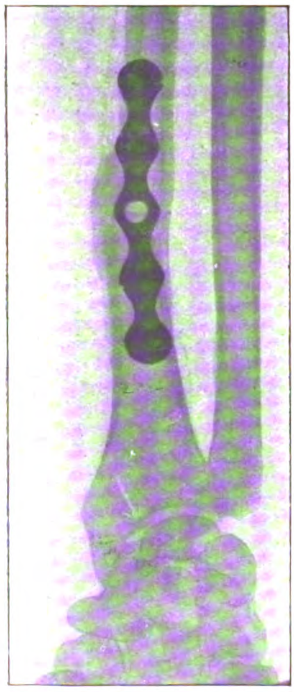

FIG. 4.

To illustrate "On the Treatment of Fractures of Long Bones," by Major GORDON TAYLOR.

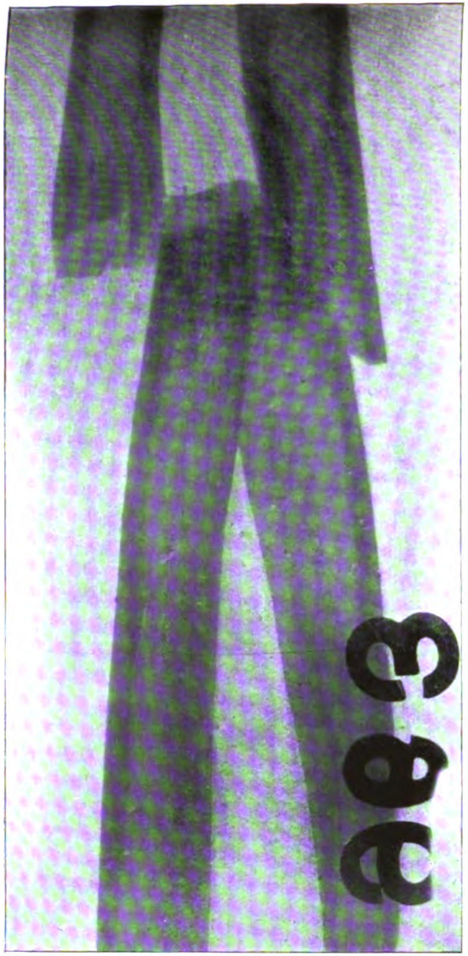

FIG. 5.

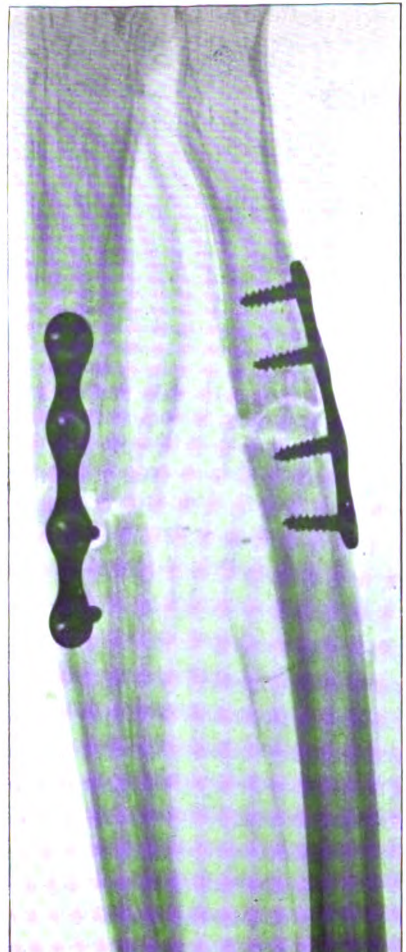

FIG. 6.

FIG. 7.

To illustrate "On the Treatment of Fractures of Long Bones," by Major GORDON TAYLOR.

FIG. 8.

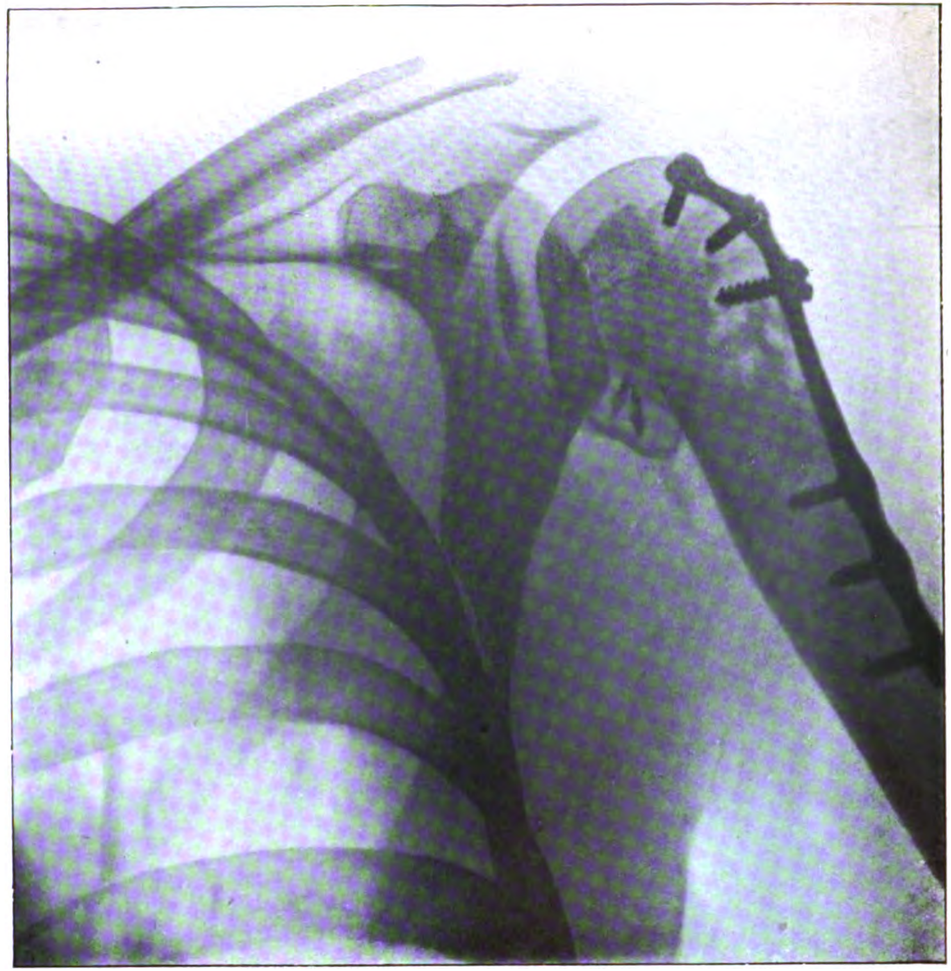

FIG. 9.

To illustrate "On the Treatment of Fractures of Long Bones" by Major GORDON TAYLOR.

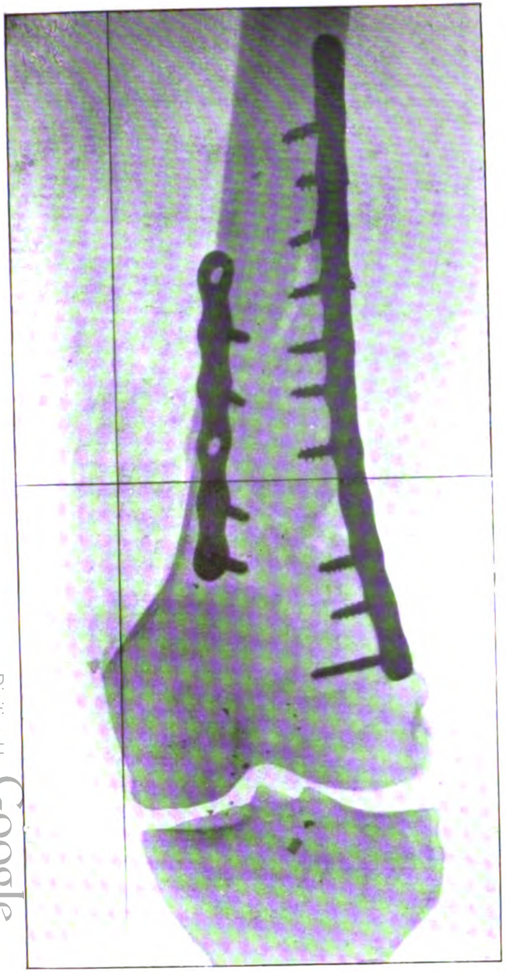

FIG. 10.

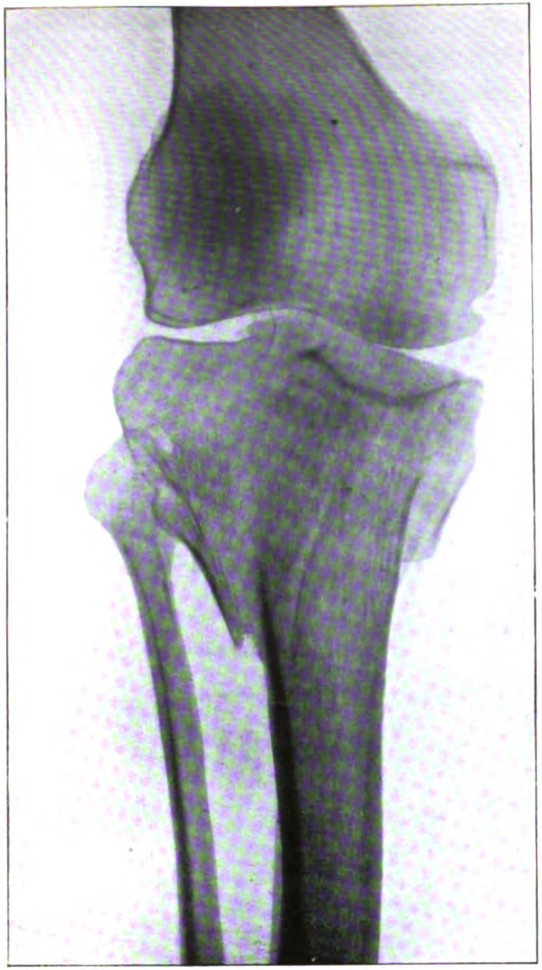

FIG. 11.

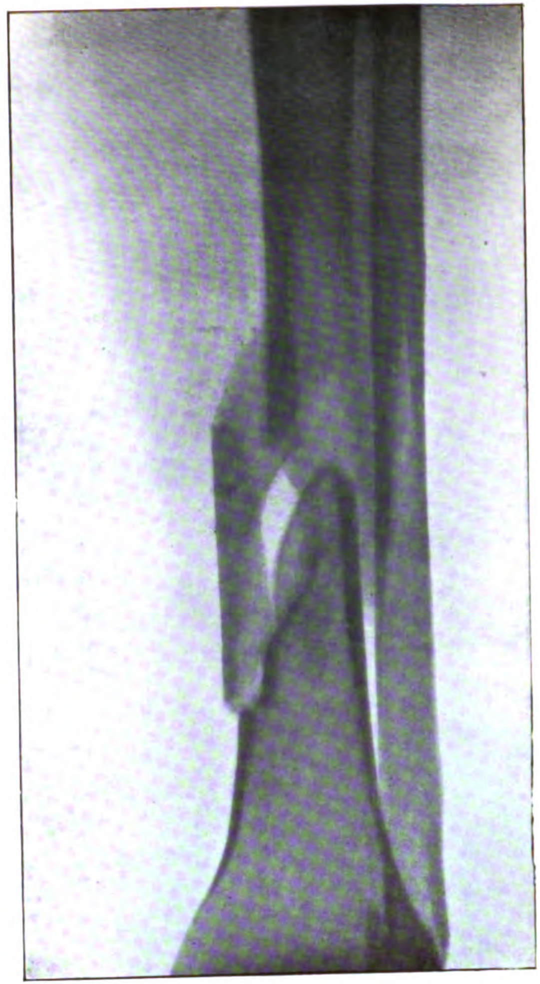

FIG. 12.

To illustrate "On the Treatment of Fractures of Long Bones," by Major GORDON TAYLOR.

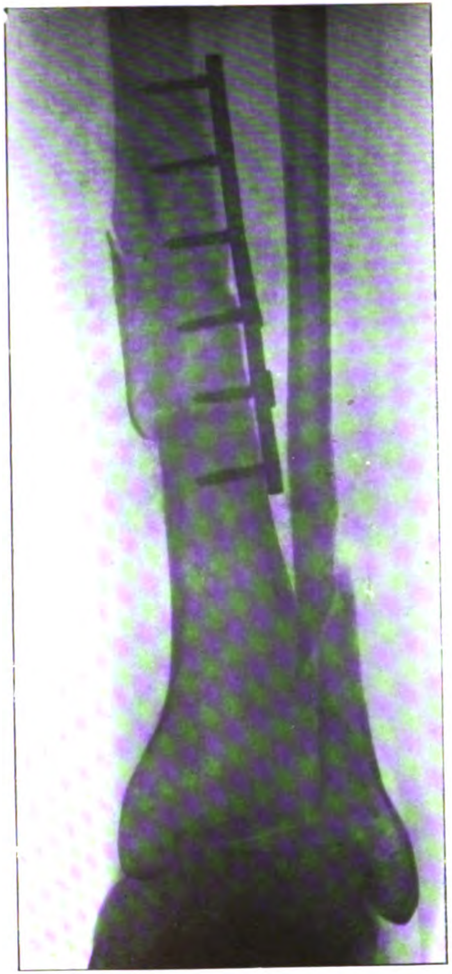

FIG. 13.

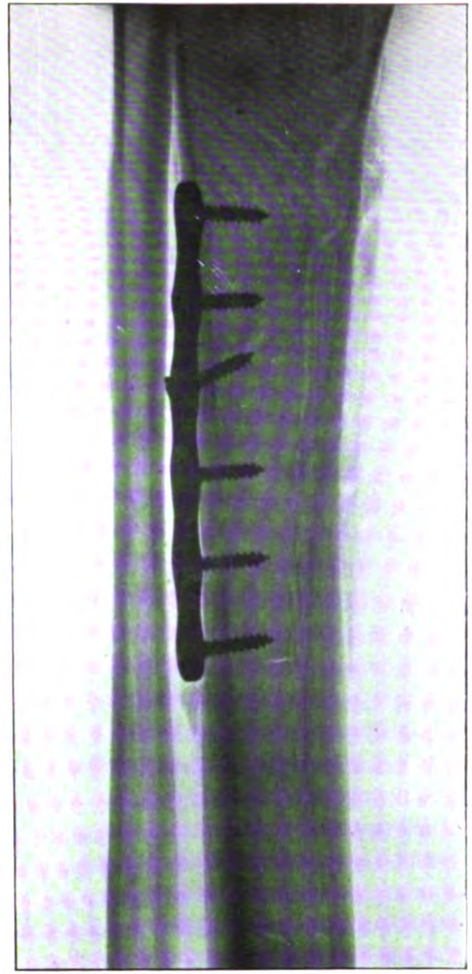

FIG. 14.

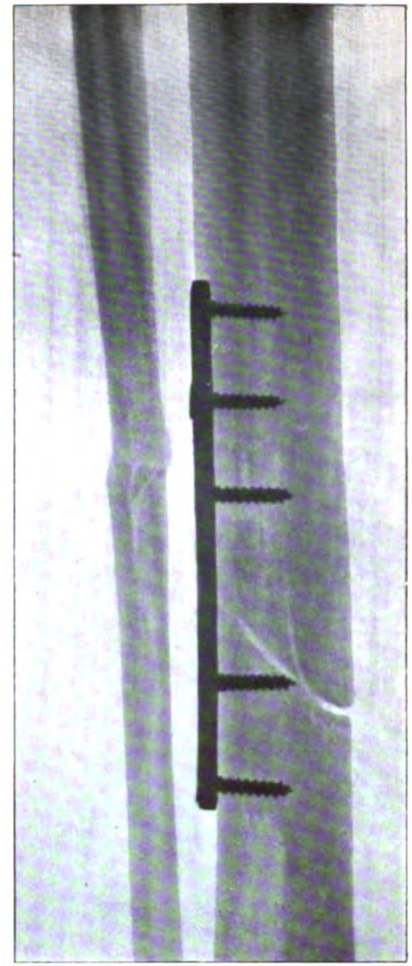

FIG. 15.

To illustrate "On the Treatment of Fractures of Long Bones," by Major GORDON TAYLOR.

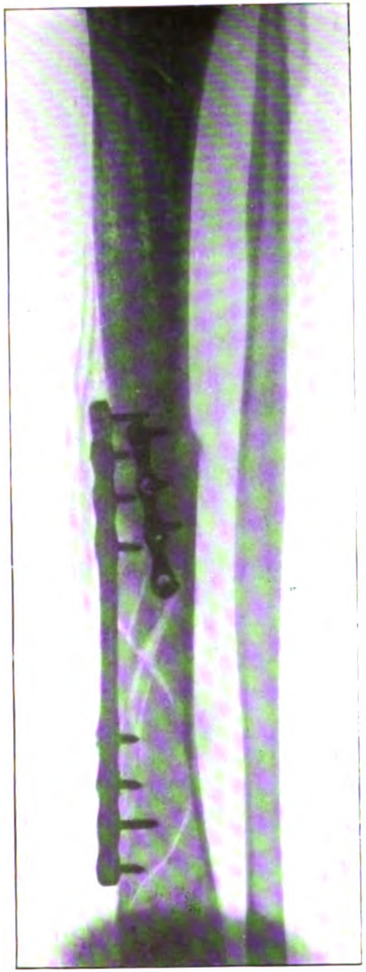

Fig. 16.

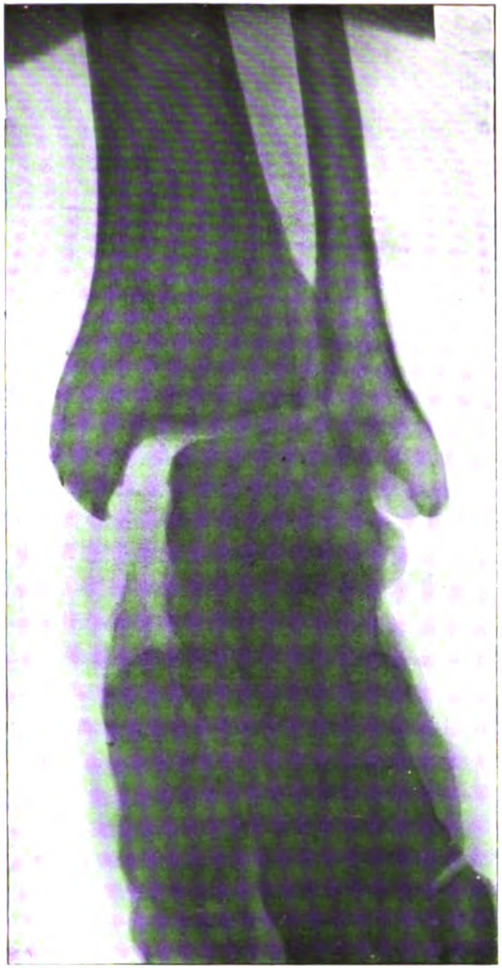

Fig. 17.

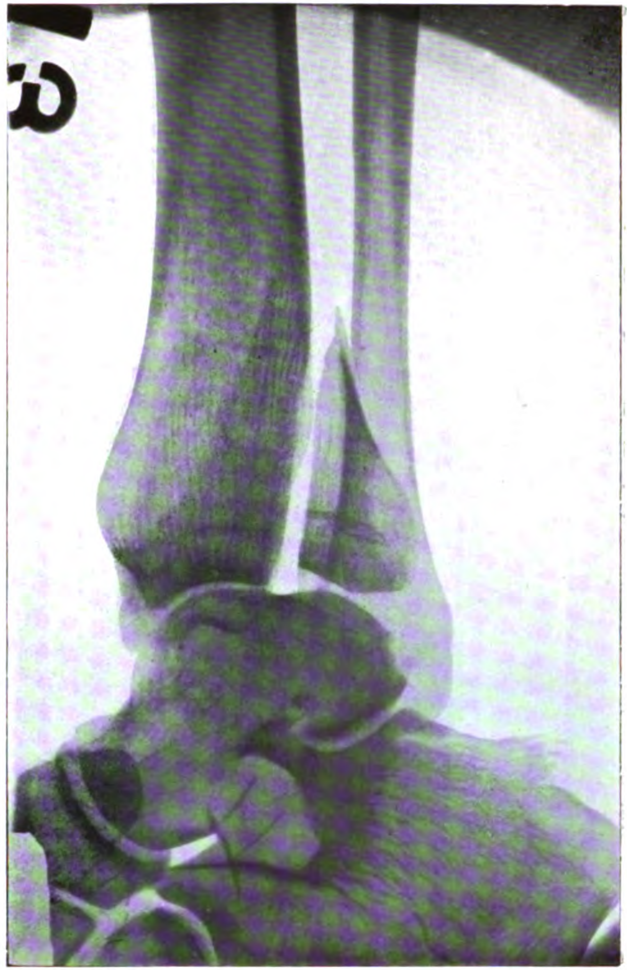

Fig. 18.

To illustrate "On the Treatment of Fractures of Long Bones," by Major Gordon Taylor.

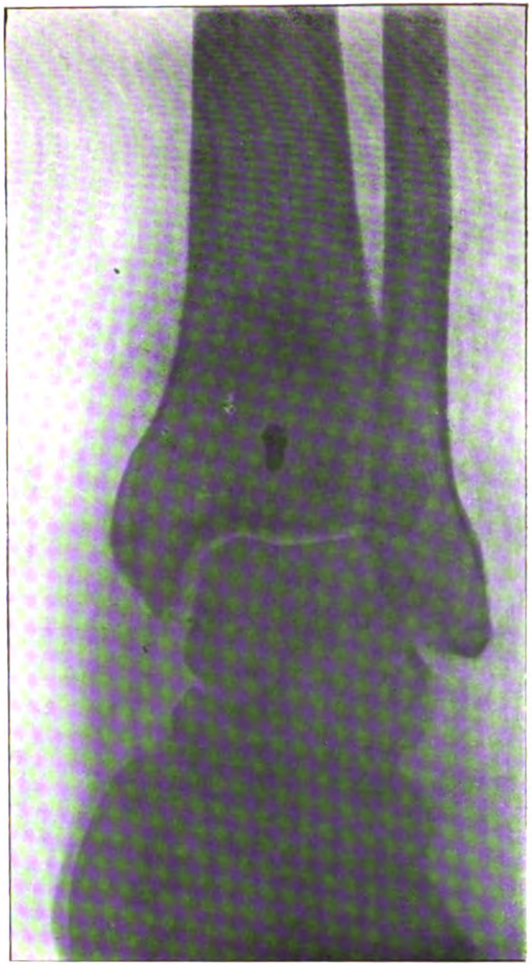

FIG. 19.

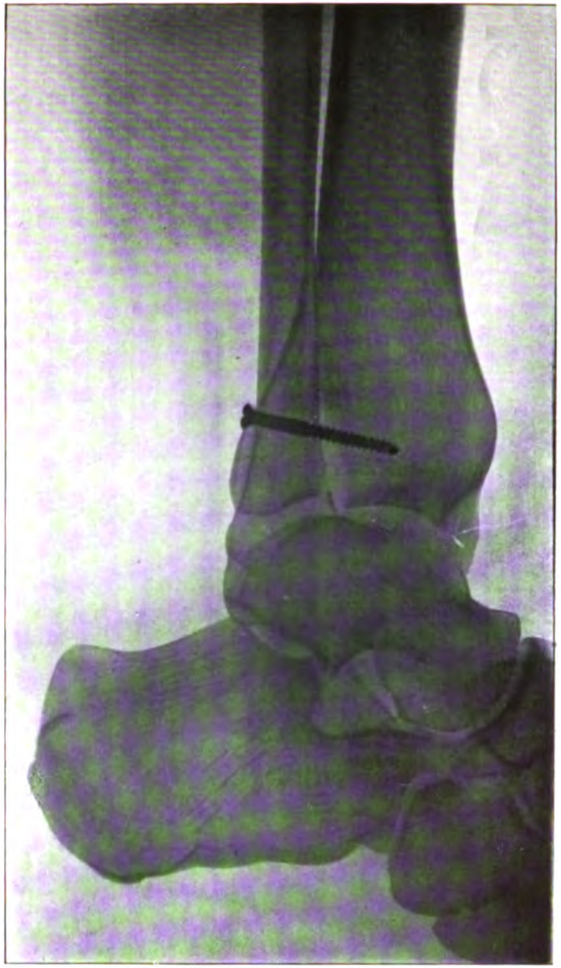

FIG. 20.

To illustrate "On the Treatment of Fractures of Long Bones," by Major GORDON TAYLOR.

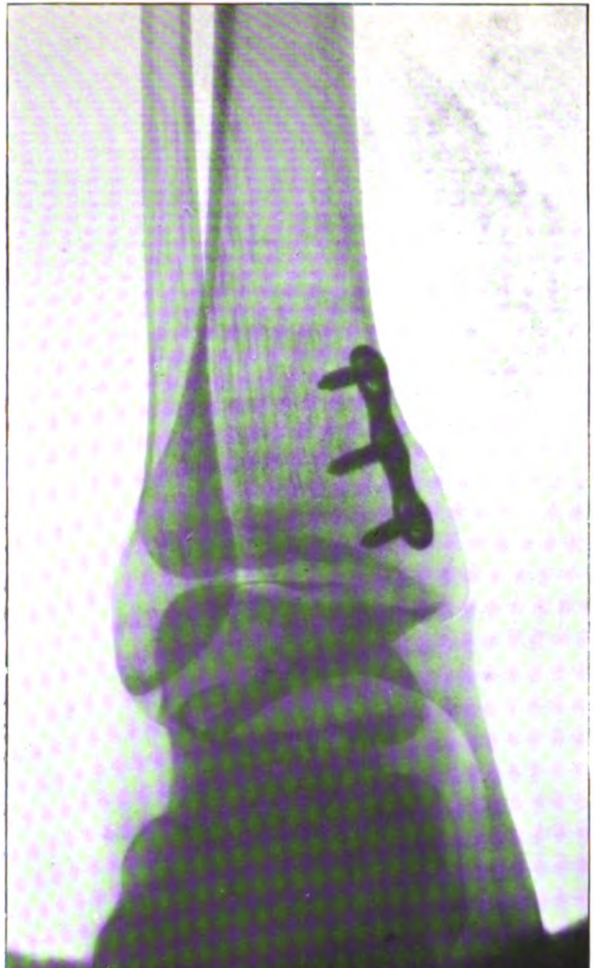

Fig. 21.

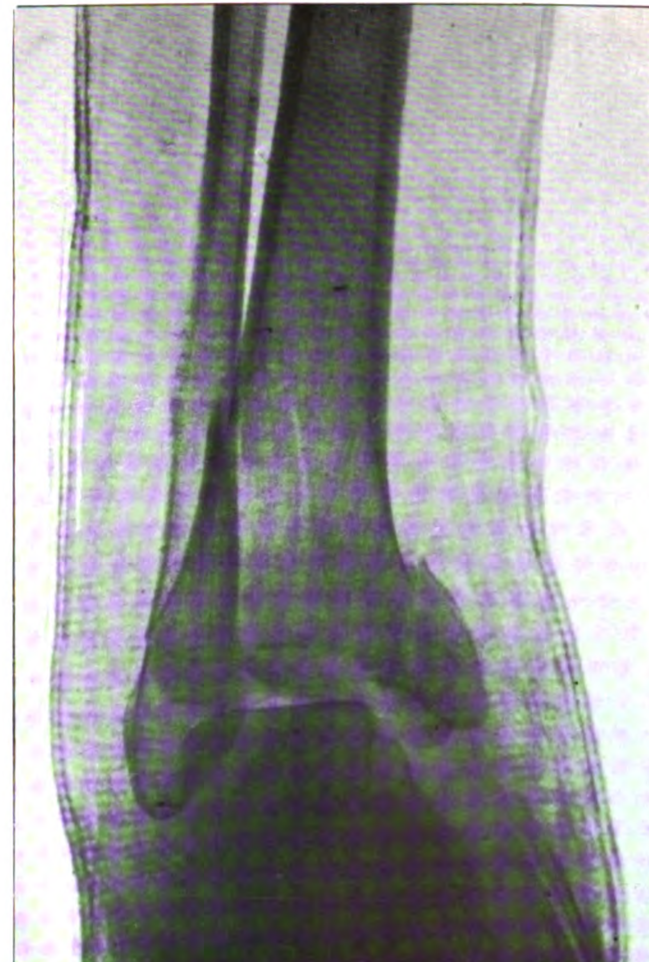

Fig. 22.

To illustrate "On the Treatment of Fractures of Long Bones," by Major Gordon Taylor.

Fig. 23.

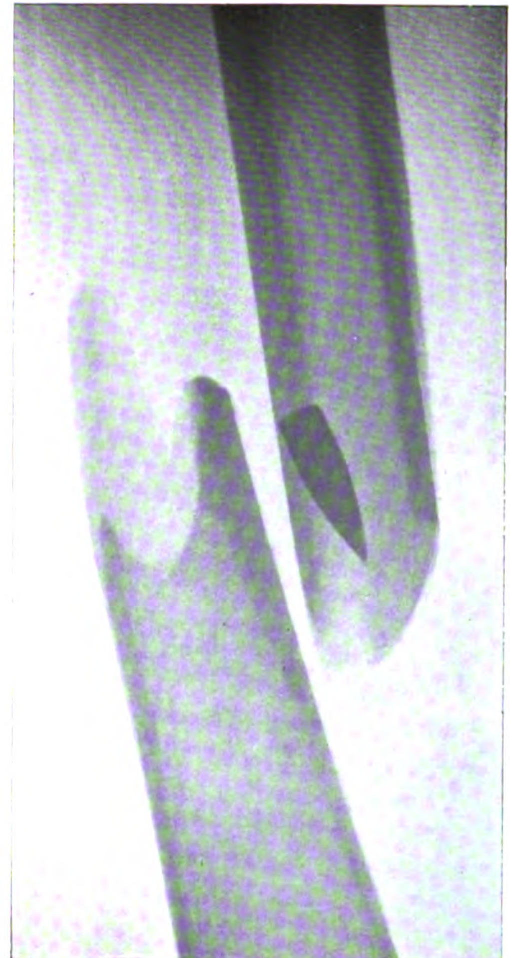

Fig. 24.

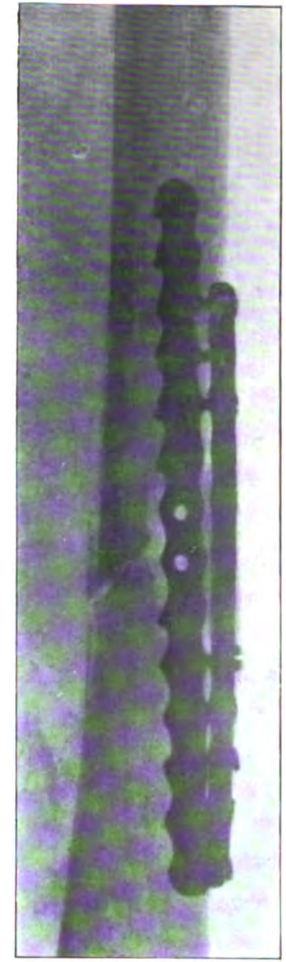

Fig. 25.

To illustrate "On the Treatment of Fractures of Long Bones," by Major Gordon Taylor.

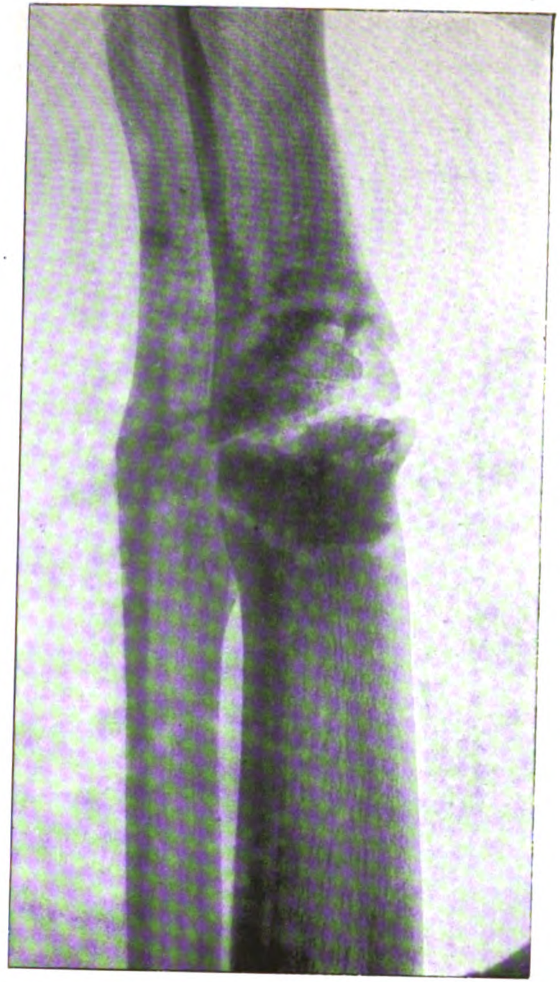

Fig. 26.

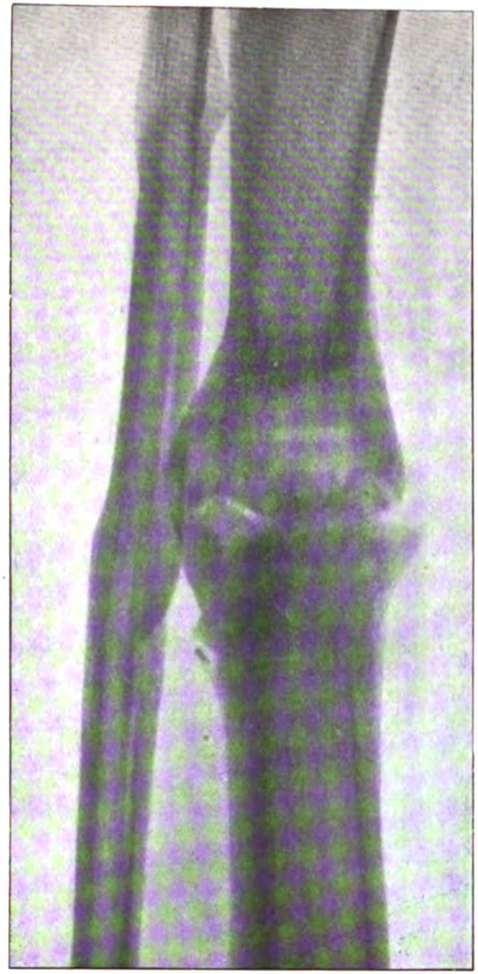

Fig. 27.

To illustrate "On the Treatment of Fractures of Long Bones," by Major Gordon Taylor.

Case 7.—*Fracture of Tibia.* Figs. 12 and 13 are from a torsion fracture of the tibia with a loose fragment.

Cases 8, 9 *and* 10.—*Fractures of Tibia.* Figs. 14, 15, 16 are examples of torsion fractures of the tibia treated by plating.

Case 11.—*Abduction Fracture of Ankle.* Figs. 17, 18, 19, 20, are taken from one variety of abduction fracture of the ankle treated by the introduction of a screw. It will be observed that the normal relations of the internal malleolus and the astragalus have been restored by the operation.

Case 12.—*Fracture of Internal Malleolus.* Fig. 21: this resulted in a freely movable ankle-joint.

Case 13.—*Adduction Fracture of Ankle.* Figs. 22 and 23 are from an adduction fracture treated by plating. A freely movable ankle-joint resulted.

The treatment of fractures and injuries of bone due to gunshot wounds has taken a large and important place in the history of the present war. In the early months of the war, ill-advised plating and screwing operations were frequently performed upon septic compound fractures associated with gunshot wounds. Such operators were clearly ignorant of the cardinal rule of fracture surgery, that no open operation upon a compound fracture involving the use of foreign material in the bone should ever be undertaken in the presence of a recent septic wound. Such cases if thus treated end almost uniformly in disaster. Arguments in favour of the practice in war surgery there certainly have been; thus it has been urged that it speedily relieves the pain of a wounded man, that it renders frequent dressings less painful, and that it facilitates the transport of the patient to the base, and to England.

Hey Groves [3] in his excellent epitome, in condemning the proceeding, urges against it: (1) The extensive opening up of the soft tissues to infection; (2) the infection of the bone marrow by drilling; (3) the risk of increasing comminution; (4) the danger of causing necrosis; (5) the ultimate loss of the limb.

It is now established that early plating operations in these cases must never be done. The War has awakened a wondrous interest in new splints and mechanical measures for controlling fractured limbs. Surgeons have vied with each other in devising clever and ingenious pieces of apparatus. One has only to see the results of fractured limbs, treated for example by Major Sinclair with his ingenious splints and netting beds, and with his gauze and glue extensions, to realize that herein lies the appropriate method of treatment for the gunshot fractures of war. Efforts to get the best possible alignment should be made in the very early stages. Into the controversy on the treatment of gunshot fractures by the Thomas system as against the treatment by the weight-pull, it is not proposed to enter; excellent results have been got by both methods. At one period a tendency was observed to adopt a "wait and see" attitude in the

matter of the treatment of the shattered bones, the surgeon's attention being entirely focussed upon overcoming the sepsis, and plating operations were postponed until the wound was thoroughly healed. It must be borne in mind, however, that it is never perfectly safe to operate upon a compound fracture, even when the wound has been healed for months, and experience of war wounds teaches that the period of time in which infection lurks may be estimated, not in months, but in years. The sepsis is extremely liable to be reawakened by the long incisions and extensive stripping up of the tissues necessary to secure proper access to the damaged bone, and such a recrudescence may be so violent, *even after eighteen months* have elapsed, as to make the surgeon anxious about the fate of the limb, or even about the life of the patient.

In some cases excellent alignment may be got by the use of the transfixion pin and weight extension, as recommended by Hey Groves; this necessitates only a slight operation, and moreover can be carried out at a very much earlier date than is advisable in plating operations. Some of our late cases at Aldershot have done exceedingly well when treated by the transfixion nail.

As regards late plating operations for gunshot fractures, it must be admitted that some have healed without any microbic conflagration whatever, and good results can be shown (*vide* figs. 26 and 27, and *Practitioner*, March, 1916), but in some the wound has suppurated badly, plates have become loose, very erratic and irregular osteogenesis may occur, sinuses persist, and non-union may result. These remarks are by no means intended to imply a universal condemnation of plating operations upon gunshot fractures, but another year's experience has taught me to exercise *extreme caution* before embarking upon such operations, even many months after the original injury.

One has only to see and read the very brilliant series of cases of gunshot fracture published by Sir Arbuthnot Lane in the *Practitioner* of 1916, to realize that in his hands at least most dramatic results have been attained; but in cases where the sepsis has been very marked and persistent, probably an osteotomy through a small incision and the use of a Thomas's splint, or of a Hey Groves nail and weight extension, is a safer practice and can be used at a much earlier stage.

In gunshot fractures I would therefore urge that: (1) Every effort should be made to gain the best possible alignment at the very outset by non-operative measures; and (2) to maintain that alignment by means of such splints as absolutely immobilize the fragments, thereby promoting union, controlling and limiting bacterial activity, relieving pain, and I am forced to the conclusion that in *the case of gunshot fractures even late plating should be reserved for only very exceptional cases.*

Case 14.—*Gunshot Fracture of Femur.* Figs. 24 and 25 are taken from a gunshot fracture of the femur. On admission the wound was only slightly septic, but expectant treatment in the matter of interference was

adopted until the surface was soundly healed, and the bullet was then extracted. No bacterial conflagration was kindled, but several months were allowed to elapse before a plating operation was performed to secure good anatomical alignment. A good functional result was obtained, and there was no shortening of the limb.

Warning has already been given in this paper about the necessity for delay in plating operations for even the compound fractures of civil type Figs. 26 and 27 show a case of non-union following an ill-advised plating with consequent suppuration in such a case. The second figure demonstrates the effect of gorging the part with blood by means of an ambulatory splint; although no union had taken place for eighteen months after the original plating operation, bony union occurred in less than three months after the application of one of Hoeftcke's extension splints.

I gladly take this opportunity of expressing to Sir Arbuthnot Lane my appreciation of what he has taught me of the theory and practice of the surgery of fractures, to Colonel Wilson and Lieutenant-Colonel McNaught my indebtedness for permission to publish certain of these cases, and to my friends Captain James Taylor and Captain McLeod for their loyal help as my colleagues at the Cambridge Hospital, Aldershot.

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[1] Sir Arbuthnot Lane, Gordon Taylor, Drew and Freyer. *Practitioner*, March, 1916.
[2] *British Medical Journal*, 1912.
[3] Hey Groves. "Gunshot Wounds of Bone," 1916.

A CASE OF MULTIPLE ANEURISMS OF THE RETINAL ARTERIES.

By Captain J. A. PRINGLE.
Royal Army Medical Corps.
Ophthalmic Specialist, British Expeditionary Force.

Aneurisms of the retinal artery, apart from those variations in calibre associated with arterial disease, are so extremely rare that I think it may be of interest to ophthalmologists if I report the following case at some length.

Pte. C. J., aged 23, service seven months, was sent up to see me by the medical officer in charge of his base, as he had complained of some blurring of vision. On being questioned he said he had first noticed that his sight was defective some eighteen months previously, that it was much better now than it had been, but that when he tried to use his

eyes for close work, e.g., to read a thermometer, that the figures got blurred and seemed to move "up-hill." He also said that when he stooped and raised his head quickly his eyes ached at the back, and that disks and rings seemed to float in front of him. In appearance he was a fairly well developed man, apparently healthy, save for a slight tendency to anæmia. There was so sign of thickening of the peripheral arteries. The urine was reported normal.

Family History.—Father alive, said to have diabetes, but no eye trouble. Mother died of cancer. Four brothers and one sister all healthy and nothing wrong with their eyes as far as he knows. No history of tubercle or syphilis.

Previous History.—Patient has always been healthy, no serious illness, no injury; has never worn glasses. He started work as a miner when 16½ years of age, and worked constantly in the pits until two months before enlistment, when he went off work owing to his vision becoming blurred and things seeming to go round. The doctor told him then that he had nystagmus. He started work again about ten days before enlisting and left work to join.

On examination there is nothing to note externally in either eye—pupils equal and active—tension normal. Slight nystagmus can be elicited in the extreme positions of the eyes. Vision of right eye $= \frac{6}{6}$ $\bar{c}$ $+ 0{\cdot}5$ cyl. axis 45 D and I $= \frac{6}{5}$ partly. Vision of left eye $= \frac{6}{5}$ partly. No refractive error.

Left Fundus.—There is some increase of connective tissue round the disk and along the vessels, but there is no sign of medullation at the disk. On following the superior temporal vessels outwards for about 2½ to 3 disks' diameters a large patch of medullated nerve fibres begins to make its appearance. These fibres start as a compact opaque bundle along the course of the vein and gradually spread out on either side into long fine silvery threads which follow the line of the main vessels and gradually fade off into the normal retina about three disks' diameters further out. At one point the upper of the two main branches of the superior temporal artery crosses behind the vein, and here the artery is completely hidden by these fibres. Still further out and at a lower level there is another area of medullated fibres, but this patch is much smaller than the first and is very poorly defined, being represented merely by a few faint silvery lines running across the course of the lower branches of the superior temporal vessels.

But the most striking feature in the fundus is the presence of three large swellings along an artery immediately below the first mentioned patch of medullated fibres; two of these swellings are pale pink with bright reflexes which gives them a pearl-like appearance, while the third or centre one is of a deep carmine colour.

As the artery along which these swellings are situated presents

several other features of interest, I propose following its course outwards from the disk and describing in detail each abnormality as it presents itself.

The superior temporal artery divides into two branches of equal size at a short distance from the disk. The upper branch follows the course of the vein crossing first in front of this vessel, and then, at a short dis-distance further outwards, recrossing behind it. It is upon the lower branch, which runs above the macula and is not involved in the area of opaque nerve fibres, that the aneurisms occur. After giving off two twigs to the macular region this artery sends a small twig almost vertically upwards and just beyond this point, which is about 3½ to 4 disks' diameters from the papilla, there are two small oval brightly reflecting spots of a white or pearl-grey colour lying one beyond the other on the centre of the vessel, with their long axes parallel to its course. There is no increase in the calibre of the artery and beyond the fact that its normal central light reflex is interrupted by these two spots and that the vessel behind them, except where they actually hide it, shows pink in colour, there is nothing further to note. Immediately beyond the second of these two dots is a large fusiform expansion bulging below rather more than above and in size about 3½ times the diameter of the vessel. At the peripheral end of this expansion and before the calibre again becomes normal, there is a second smaller fusiform expansion about twice as large as the diameter of the vessel. In shape these two are like the two bulbs of the old-fashioned soda water syphon, the length of the first being about four times, and of the second about twice the diameter of the vessel. The appearance of the first expansion is very striking and can best be compared to that of a pale pink pearl. On the summit of this expansion and slightly below its centre there is an oval area with bright reflex similar in appearance to that of the first two just described, but longer. Curving above and below this reflex can be seen the pale pink shading of the blood-stream, which has a flattened out appearance, but this as well as the colour are probably due to the fact that the blood is seen through a thickened vessel wall. The second or smaller expansion is also pale pink in colour with a marked reflex on its upper part. It also shows the usual bright oval reflex on its summit. The lower part has a deeper pink colour, probably because here the blood-stream does not appear to take a straight course through the expansion but fills its lower half which apparently has comparatively thin walls, while the walls of the upper half seem to be considerably thickened.

For a short distance beyond this point the artery is normal in all respects. It is crossed transversely by a branch of the superior temporal vein, and gives off a small twig below. Next comes a third pearl-grey spot on the anterior surface of the vessel, similar to the first two

described. Here however the vessel shows a very slight increase in calibre but the walls do not appear to be thickened. Narrowing a little, but still with a somewhat increased calibre and curving gently upwards, the artery expands into the fourth and most typical of its aneurisms.

In shape this is exactly like the bulb of a Higginson's syringe, measuring about 3½ diameters of the normal vessel in breadth and 4 to 4½ diameters in length. It is of a deep pink or carmine shade throughout, except at its centre where it shows a bright oval reflex. The walls appear thickened as they have a distinct whitish outline, but the whole expansion is perfectly uniform and is apparently completely filled with blood.

Beyond this dilatation the artery becomes perfectly normal for a short part of its course and is crossed by another twig from the superior temporal vein. It takes a gentle curve downwards and just at the bottom of this curve it shows yet another dilatation. This one is a reproduction of the first two, but is smaller, being scarcely twice the diameter of the vessel; it has the same appearance of a pale pink pearl and seems to bud out from the anterior wall of the artery corresponding in appearance rather to the sacculated type of aneurism. The blood-stream can be seen passing behind rather than through its proximal part, the walls of which appear much thickened, while its distal part takes on a deep pink colour, and appears to become full of blood as it gradually diminishes to approximately the normal diameter of the artery.

The farthest out and smallest expansion follows almost immediately on the last described before the vessel has quite regained its normal size. It seems to spring from the posterior and upper aspect of the artery, showing above the vessel as a small refractile hemisphere, the slightly enlarged artery hiding its lower half. In size it is only about half the diameter of the vessel, and is probably composed of thickened wall, as the line of the blood-stream can be seen passing across it. For a short distance, about two to three disks' diameter, beyond this expansion the vessel is slightly enlarged, but shows no thickening or irregularity of its walls, while for the rest of its course, in the ophthalmoscopic field, it is perfectly normal.

In the retina, a little way below the first aneurism, there is a minute reflectile spot, and on close examination one can make out a second still more minute grey speck below the Higginson's syringe expansion. No blood-vessel is in connexion with either of these.

No enlargement of either the arteries or veins on the papilla is apparent, nor can the slightest abnormality be detected on any other of their branches as far as they can be traced towards the extreme periphery of the fundus. As compared with the retinal vessels on the disk of the other eye, beyond the fact that the left superior temporal vein is a little fuller than the right, no other difference is observable.

The branch of the artery on which the aneurisms occur is normal in every respect up to the point where the first refractile spot appears.

I was unable to detect any spontaneous pulsation, either in the arteries or in any of the expansions. The venous pulse was well marked on both disks. Pressure on the globe gave very distinct pulsation in the arteries, and this pulsation could be traced into the branch with the aneurisms, but I was disappointed in not being able to produce obvious pulsation in any of the aneurisms themselves or in the artery beyond,—although by very closely watching the white outline around the Higginson's syringe expansion, I satisfied myself that there was a faint but distinct expansible movement, and that the expansion was definitely reduced in size.

Right Fundus.—The inferior temporal and inferior nasal arteries and their branches show similar dilatations to those described in the left eye. The majority of these swellings are situated at the extreme periphery of the fundus, and, owing to the slight nystagmus, they are difficult to see and impossible to examine in detail. In all about twenty-three dilatations of varying sizes appear in the ophthalmoscopic field, nine of these being situated on the inferior temporal artery and its branches and fourteen on the inferior nasal artery and its branches. They are of exactly the same type as those in the left eye, but are rather smaller in size, possibly because they are more peripherally situated. In none of them, nor in the fundus in their immediate neighbourhood, can any signs of recent changes be detected. Both arteries show some apparent thickening of their walls at one or two points in their course between two dilatations, but otherwise except for the aneurisms they appear normal. Towards the periphery of the field, and lying above the main branch of the inferior temporal artery, some white markings appear in the retina, which are probably of a similar nature to those described in the left fundus immediately below the two larger dilatations. There is evidence of an increase of connective tissue around the disk and along the vessels in its neighbourhood.

Unfortunately, when on active service, one is able to consult only a very limited amount of the available literature on a subject of this nature; as far as I know, however, a similar case has not hitherto been described, but I am quite open to correction on this point. The question may be asked: "Are these true aneurisms?" Personally, I have no hesitation in saying they are, and this opinion has been endorsed by three ophthalmic surgeons, to whom I have shown the case. I do not think any other diagnosis is possible if the following points are considered: (1) the situation, shape, and general appearance of the swellings; (2) the fact that the Higginson's syringe dilatation is completely filled with blood, and that owing to the thickening of its walls their continuity with those of the artery is easily established; (3) that the blood-stream can be

traced through the centre of one of the aneurisms, the walls of which have become so thickened that the calibre of the stream is only slightly increased; and (4) that expansile pulsation and reduction in size can be produced in the largest of the aneurisms by pressure on the globe. Had spontaneous pulsation been present, or even had I been able to produce it markedly by pressure on the globe, it alone would have decided the nature of the swellings, but as this was so poorly defined that its presence was disputed by two out of the three ophthalmic surgeons who saw the case, I mention this fact last, giving the other arguments precedence. I think, however, that these are sufficient proof, leaving the pulsation out of account.

As regards the origin of the condition, I fear I can go no further than to suggest the probability of its being a congenital abnormality. The patient's health is excellent, and a physician, who kindly examined him for me, reported that he could find nothing wrong, so that the changes in the retinal arteries can scarcely be explained as a manifestation of any general disease which might affect the vascular system. On the other hand, the fundi show definite congenital defects both in the patches of medullated nerve fibres and in the increase of connective tissue around both disks. There is also the fact that the eyes have normal vision, and show no pathological change in any other part of the fundi. Again, there are no signs of recent changes along the vessels or in the neighbourhood of the aneurisms such as one would expect to find had the disease been progressive; and although the period during which I had the patient under observation (three weeks in all) was too short to be of any help in deciding this point, the condition certainly did not alter as far as I could judge.

The possibility of this being an early stage in the condition known as anterio-venous aneurism, eighteen cases of which have been collected and discussed by Coats in his paper in the Royal London Ophthalmic Hospital Reports, vol. xviii, on "Massive Exudation Retinitis," should, I think, be mentioned, although beyond the fact that this disease mostly attacks healthy males of from 22 to 23 years of age, and that it is generally bilateral, there is no similarity either in the history or in the ophthalmoscopic appearances to the case under discussion. The veins in this case have no connexion whatever with any of the aneurisms. A case showing venous communication, together with a patch of medullated nerve fibres, was, I believe, reported in one of the ophthalmic journals some years ago.

Referring for a moment to the symptoms complained of by the patient, I do not think these had any connexion with the changes found in both fundi, but are more probably attributable to the remaining traces of his nystagmus.

In conclusion, I should like to express my thanks to Colonel Lister,

C.M.G., Consulting Ophthalmic Surgeon to the British Expeditionary Force, for his interest in the case, and for his confirmation of the ophthalmoscopic appearances.

PRELIMINARY NOTE ON SPIROCHÆTES OCCURRING IN THE URINE OF CASES OF "P.U.O."

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Beit Memorial Research Fellow.

(*Note:* This article was received June, 1917.)

During the past few months I have examined the urine of cases o P.U.O. for spirochætes, using a modification of Renaux and Wilmaers' technique. The results are so suggestive that I venture in this preliminary note to call attention to the necessity for a systematic examination of the urine in certain clinical types of P.U.O., which may ultimately turn out to have a common etiological origin.

Since in March last Garnier and Reilly suggested that in certain cases of icterohæmorrhagic spirochætosis the chief incidence of the disease may be upon the kidney, I have examined a number of cases of trench nephritis and found a spirochæte in a fairly large proportion. Further, in what I regard as a definite clinical type of P.U.O. (appendicular or abdominal —described below) which is probably a mild form of icterohæmorrhagic spirochætosis, I have found a spirochæte almost constantly present in the urine. Again, in the relapsing type of P.U.O. (trench fever) a spirochæte can frequently be found in the urine, during and immediately after the exacerbations of temperature.

Methods.

The technique which I have been using is as follows :—

At first the specimens of urine were obtained in the ordinary way, and brought to the laboratory in clean bottles; but later, precautions were taken to try and avoid contamination of the samples. After drawing back the foreskin, the prepuce and meatus were swabbed with a 1 in 1,000 hydrarg. perchlor. solution; the patient then passed urine, and a sample towards the end of the act of micturition was caught in a large sterile test-tube. The urine was centrifuged and at first, after pouring off the supernatant fluid, the deposit was washed with sterile water and re-centrifuged. Control experiments showed, however, that the spirochætes seem to be of comparatively low specific gravity, requiring therefore

prolonged centrifuging (ten minutes at least, and the longer the spinning is kept up the greater the number found) and care not to remove the lowest layer of supernatant urine before re-centrifuging. So it was found easier, once one learnt the morphology of the organism, to pick it out in greater quantity even amongst a certain amount of debris, rather than to hunt for isolated spirochætes on a comparatively clean slide; and the deposit was not washed. Dark-ground illuminations not being available, the following methods of dealing with the deposit were adopted:—

(1) *Indian Ink.*—Some of the deposit was mixed intimately with a drop of "chin-chin" liquid pearl ink (Watson) on a clean slide, and a film made by drawing along the slide a small piece of cigarette paper wetted in the drop. The film so made soon dries and then can be examined directly with the oil immersion lens. Spirochætes if numerous show up readily by this method, but the debris of the urinary deposit sometimes causes confusion and difficulty. This method, however, probably shows the spirochætes in a more natural condition than when mordants and dyes are used.

(2) *Tannic Acid and Carbol-fuchsin* (Renaux et A. Wilmaers).—Films are made of the deposit and fixed for ten minutes in absolute alcohol; then covered with 5 per cent tannic acid solution, and warmed till steaming; then well washed with distilled water, and without drying stained with carbol-fuchsin, steaming for half a minute, washed, dried, and examined. This is a very simple and rapid method, but does not give such a clear-cut picture as silver nitrate.

(3) *Tannic Acid and Silver Nitrate* (*Fontana*).—The films are fixed with repeated washes of fixing fluid (acetic acid one cubic centimetre, formalin twenty cubic centimetres, aq. dest. 100 cubic centimetres), then washed well with distilled water, flooded with mordant (tannic acid five grammes in 100 cubic centimetres, aq. carbolic solution one per cent), and warmed for thirty seconds, then well washed with changes of warm distilled water, flooded with one per cent silver nitrate and warmed gently for half a minute, washed and mounted in balsam.

Spirochætes.

The spirochætes have the following characters:—

They are about one to one and a half times the diameter of a red blood corpuscle and are very thin, the ends tapering.

They show five to eight more or less regular turns, and may be straight, bowed, or lying in a semi-circle.

The spirals are not so fine as in *Spirochæta pallida*, nor so coarse as in the spirochæte of Obermeier.

The organisms are very resistant to staining, being uncoloured by Leishman, Romanowsky or Giemsa's stains, and requiring a mordanting method, but may be demonstrated by Indian ink methods.

They occur in the urine, often abundantly, during and immediately after the rise of temperature, but in the intervals may be so scarce as to be practically absent. Like McNee and others, I have been unable to find any organism by direct examination of the blood of these patients, and I have not had an opportunity of determining post mortem at what part of the urinary tract the spirochætes originate.

Results.

The following are the cases in which I have found spirochætes in the urine :—

Trench nephritis	3 cases
Pyelonephritis, with abscesses of lungs ..	1 case
Relapsing P.U.O.	15 cases
Myalgia following P.U.O.	1 case
N.Y.D. appendicitis	5 cases

Whether, in these different cases, we are dealing with the same spirochæte I am unable to state at present.

Clinical Aspect.

These observations suggest that we may be able to bring into line at least two clinical types of P.U.O.

(1) A disease with acute onset with chills, and vomiting, pain in the abdomen, usually more marked in the right upper quadrant, running a continued fever for several days, often with enlargement of the spleen and herpes of the lips. The pulse-rate is not increased, and is usually slowed to fifty to sixty beats per minute in the convalescence. There is a leucocytosis of 12,000 to 25,000 with relative increase in the large mononuclears. The cases, if an attempt is made at diagnosis, come to the base as "? Appendicitis" or "N.Y.D. abdominal." I recognize that these are the cases which presented nothing but a normal temperature, malaise and slow pulse, and were evacuated to U.K. In three such cases last year I remember a note coming from Captain Stokes to the effect that the guinea-pig into which the blood of the patient had been injected had died on the ninth or tenth day with signs of spirochætosis. In his published cases he notes that the urines of the patients were examined with negative results. In these cases now I find spirochætes almost constantly in the urine. French authors have suggested that cases of icterohæmorrhagic spirochætosis may have almost their whole incidence on the kidney, and so one finds spirochætes in cases which cannot be distinguished from acute (trench) nephritis, except, perhaps by the long continuance of much albumin and kidney debris in the urine.

(2) The relapsing type of P.U.O. (trench fever) with the characteristic

periodic rises of temperature, myalgic and periosteal pains and a leucocytosis with or without enlargement of the spleen, in which an improving technique has enabled me more and more frequently to find a spirochæte in the urine during and immediately after the exacerbations of temperature.

I wish to thank Lieutenant-Colonel C. J. Martin, A.A.M.C., for his advice and interest in this work, which is being continued.

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[1] Renaux et Wilmaers. *Paris médical*, March 3, 1917, p. 196.
[2] Garnier et Reilly. *Paris médical*, March 3, 1917, p. 176.
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SKIN DISEASES AND THEIR TREATMENT UNDER WAR CONDITIONS.[1]

By MAJOR H. MACCORMAC, M.D., F.R.C.P.
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WAR is a very serious business in which every detail counts towards the final triumph of victory. Essential above all things is the maintenance of man-power; every soldier unfit for the firing line is a gain to the enemy, and for military purposes it matters not what removed him from the line, only that he has been removed. In the present war the losses occasioned by diseases of the skin have been considerable, and therefore we, as dermatologists, are much concerned with two questions: first, whether our art can prevent them, and second, when they have arisen how we can best cure them.

In France the problems presented are new; unusual types of skin affection have arisen, while the progress of war, the environment of an army in the field, its ebb and flow and the complicated movements of its being, render impracticable those processes familiar in the quiet habit of civil life.

[1] Read before the Section of Dermatology, Royal Society of Medicine, April 19, 1917.

The author is indebted to Mr. A. K. Maxwell for his skill and care in making the drawings, and to the Medical Research Committee for the provision of his services.

Humanitarian principles compel us, and rightly, to give our best aid to those who by reason of grievous wounds or severe sickness can never more fight. In dealing with diseases of the skin, we are content to know that not only are we alleviating illness but, further, since nearly every case will return to duty, we are able to add considerable reinforcements to the Army. We are dealing with men whose health is but little impaired, many of whom are highly trained soldiers, and who from a purely military point of view are of the utmost value to the combatant forces. I particularly desire to emphasize this point because it is so necessary to insist that the employment of the highest skill and the best methods are well repaid by the results obtained.

The work of a dermatologist is important for a further reason. Where so large a proportion are affected with contagious disease, the cure of one case may mean the prevention of many others.

The problem is no new one; in the medical history of past campaigns we may read how severe and extensive skin complaints were. During the American Civil War, out of an army of some 600,000 men, 32,000 cases were diagnosed as itch, and another 35,667 were merely recorded as skin disease. So severe was the former complaint that its pathology was much disputed at the time.[1] During the Napoleonic campaign cases of itch were counted by the hundred thousand,[2] and in his admirable observations on diseases of the Army in camp and garrison Sir John Pringle refers to its existence in his time.[3] And so the tale goes on through the New Zealand and South African wars.

We have therefore sufficient precedent to compel us to consider the problem seriously, evidently no light one. In the past typhus and typhoid played frightful havoc in field and camp; these diseases medical science has curbed—a triumph amply recognized—the scourge of scabies still, however, survives to the present time.

With such evidence before us, from both the past and present, it is, I think, apparent that the scope of dermatology in war is considerable, and not in our Army alone but in those of our Allies

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[1] Munson's "Military Hygiene," Lond., 1901, p. 606.

[2] Hirsch, "Geographical and Historical Pathology," ii, p. 360 (New Sydenham Society's translation).

[3] Sir John Pringle, "Observations of the Diseases of the Army in Camp and Garrison," Lond., 1752, chap. viii.

also. At the commencement of hostilities the Belgian Army suffered considerably from itch. M. le Médecin Principal Dupont tells me that this has been very largely checked, no doubt in consequence of an admirable bathing system and the establishment of dermatological centres in various sections, where expert opinion and treatment are available. Where troops are moving forward rapidly over contested ground, such fixed arrangements are hardly practicable.

In Paris, the Director of St. Louis Hospital assured me that the incidence of scabies in the troops has been greatly lessened since the beginning of the War. The French Army has also established dermatological centres. So far as could be observed, the cutaneous affections amongst French soldiers were less severe than those seen in our troops, probably as the result of these arrangements.

In the British Army at the Front, a man reporting sick comes under his own medical officer, by whom he may be evacuated to a field ambulance, thence to a casualty clearing station or base hospital. The question arises where skin complaints can be most efficiently dealt with, and this demands consideration from several points of view. The regimental commanding officer is naturally loth to lose a soldier suffering from what appears to be a trivial complaint; but since regimental treatment cannot be efficient under war conditions, and as the danger of infecting other men is considerable, it should be definitely ruled that regimental treatment should not be attempted.

What plan can be followed? Obviously, the best results are to be got in fixed institutions with expert personnel. Now from their nature and purpose neither field ambulances nor casualty clearing stations come under this heading. On the other hand, a scabies station for each Army Corps would fulfil these requirements admirably. It is argued against the establishment of such units that this means the unnecessary creation of new hospitals to which medical officers and quartermasters would have to be detailed. Those who reason in this manner overlook the fact that these stations would release beds and personnel elsewhere employed in the treatment of skin diseases, and that since each medical officer can deal with a large number of skin cases an actual saving would be effected. They forget that skin patients must be housed and treated somewhere; they doubtless fail to

appreciate that special departments make for speedy cure. I submit the argument, then, that corps scabies stations would both shorten treatment and effect a saving of personnel, two points which, if sustained, are very worthy of consideration.

The adoption of such a system would not end the administrative difficulties. To attain the best results, it is essential that early cases be selected. I suppose hardly any battalion is completely free from itch. Regular medical inspection is necessary, often most difficult to arrange. Since scabies in France differs in some important features from the form seen in civil life, medical officers must know what to look for. The hands are often entirely free from lesions, while interdigital burrows, that pathognomonic sign, are only present in about thirteen per cent — this figure was obtained by Captain Small, R.A.M.C., in an examination of sixty consecutive cases.

The problem is further complicated by the presence of lesions and itching caused by pediculi. The louse-bitten soldier regards pruritus as a normal accompaniment of his life. I have been amazed whilst watching a stream of men passing through divisional baths to observe how extensively their bodies were covered with numerous red papules produced by this insect. No, or hardly any, secondary scratch marks so characteristic of the phthiriasis of hospital out-patients are seen. The pediculosis is acute rather than chronic, and presents a close resemblance to scabies, at times most puzzling. Fortunately the louse, so far as I know, never attacks the penis, while this organ is frequently affected in scabies, and the presence of papules or crusts there is of the greatest help in forming a diagnosis.

These difficulties in diagnosis have occasionally led to the most amazing errors. I have seen vaccines given for long periods —up to six months—for the complications of unrecognized scabies; I have seen opium given to relieve its itching; I have even seen lesions burnt out with solid silver nitrate. In this I do not think medical officers are altogether to blame. Text-book descriptions are misleading when applied to the disease as seen in France. Even so distinguished an expert as Dr. Adamson in a recent paper[1] lays stress upon itching, a symptom sometimes of little account, and interdigital burrows, a sign frequently completely absent.

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[1] H. G. Adamson, *Lancet*, 1917, i, p. 221.

Any system of regimental inspection, for the detection of scabies, must permit of an examination of the whole body and above all of the penis. Interdigital vesicles rather than burrows should be sought for; impetigo of the buttocks is pathognomonic of scabies, and every patient with boils should be regarded as suspicious, as they form 28·4 per cent of the pyodermic complications, either alone or associated with impetigo.

The treatment of scabies opens a wide field for discussion. In this, prevention is of primary importance, and demands some comment. How does a soldier acquire this disease? Dermatologists insist that prolonged and intimate contact is necessary. Since opportunities for removal of clothing are comparatively rare and offer themselves only when in rest, infection must occur at this time, and as it is then that blankets are chiefly used, reason points strongly to them as the means of transmitting the disease. This argument is strengthened by the history of epidemics amongst officers occupying the same dug-out. No doubt horses and a venereal origin account for some cases—a small and negligible class.

It is perhaps a counsel of perfection, but were it possible to disinfect blankets more frequently, using for example the Clayton sulphur vapour method, one is tempted to believe that scabies would be greatly lessened.

Another source of infection—viz., the importation of fresh cases from England or the base—merits some passing reference. The watchful draft-inspecting medical officer soon catches and removes these men, but he is powerless to deal with the scabies "carrier," the individual who has been partially cured by methods such as sulphur fumigation. In spite of the lukewarm reception accorded to this method of treatment by this Section, it has a considerable vogue and enjoys an undeserved popularity. In the discussion to follow, I hope speakers will express their experience and views of this treatment and its modifications.

Military authorities are well aware of the losses occasioned by itch. In Base Hospital B it has been found that when severe pyodermic infections have occurred a patient remains under treatment on an average 31·7 days. This does not include additional time spent in other hospitals and in transport.

These complications are so severe as to suggest the presence of an unusual type of acarus. Specimens were sent to the British

Museum. Mr. Hirst very kindly examined them for me; he reports that "The examples certainly seem to belong to the human variety. The size is quite typical, and also the structure of the dorsal scales,

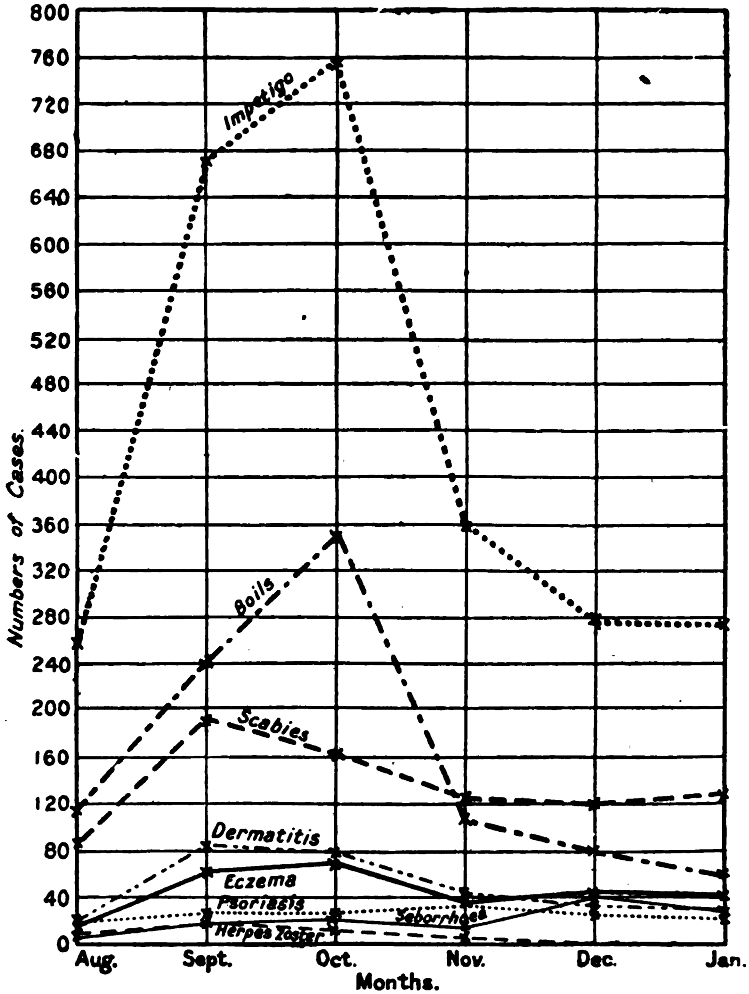

CHART I.—Admissions to Hospital B, representing graphically the more important groups.

which are longer than wide and acutely pointed, instead of being rather shorter and blunter as in var. *equi.*"

Chart I illustrates the more important admissions of skin diseases into Hospital B from August to January inclusive.

Especially striking is the curve of the impetigo; note should also be taken of the similarity between this curve and those of boils, scabies, dermatitis (unclassified) and eczema. The rise corresponds with, and to a large extent results from, the offensive of last summer. I have, however, shown it for other reasons. When examined in conjunction with Chart II it can be seen what an important part scabies and its complications play in the causation of skin disease in the Army. Chart II represents graphically the analysis of 1,000

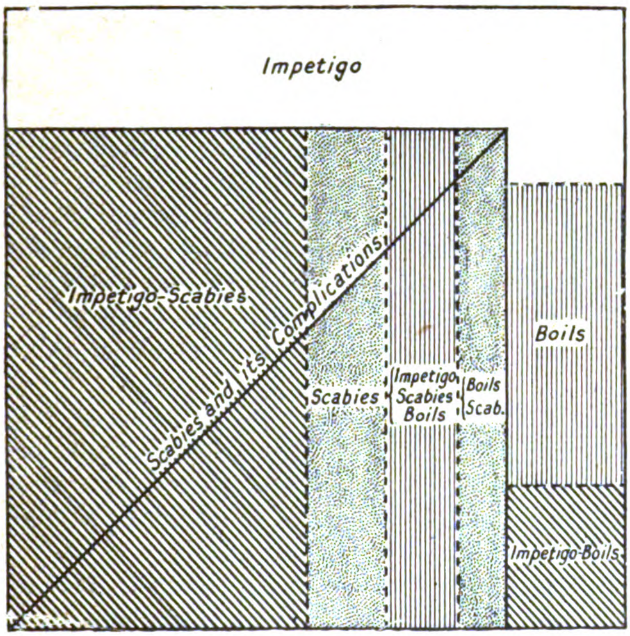

CHART II.—Analysis of 1,000 cases diagnosed as scabies, boils, or impetigo.

cases, diagnosed as scabies, boils, or impetigo, diseases that are responsible for by far the greater number of admissions. Of these, 65·9 per cent. can be directly attributed to scabies. From this it follows that if it were possible to prevent or give early treatment to this disease, a very large number of beds would be free for other purposes, and this holds true of very many hospitals both at home and abroad.

Opinion is not unanimous as to the best method of treating itch. Under conditions of active service, that is best which is most suit-

able for the majority, most easily carried out, and least expensive.[1] Any system to be effective must fulfil three conditions: Burrows must be opened to permit access of the parasiticide to the insect and ova; the parasiticide should be of such a nature as to destroy the parasite without producing dermatitis; finally, to prevent re-infection, contact clothing and blankets must be disinfected. The first of these conditions is achieved by a hot bath, soap and a soft brush; the second by the application of sulphur ointment twice daily for three consecutive days, and the third by means of any steam pressure or sulphur vapour apparatus. In this, as in any other system, to be effective it must be thoroughly and conscientiously carried out. Showers and steam baths are unsatisfactory and almost useless. I have seen men coming from them with vesicles unopened. The sulphur is blamed for the inevitable failure in cases treated in this manner. To attain success, the ointment must be thoroughly rubbed in over the whole body below the neck. I have seen men applying it with trousers, puttees and boots still on; and again the failure is attributed to the application. For these reasons it is necessary for the soaping and the application of sulphur ointment to be superintended by a medical officer, or carried out by a skilled orderly.

Where pyodermic complications are so common, care must be taken to prevent cross-infection. Each man should have a separate portion of ointment. This is best arranged on a wooden shelf, beside which the patients stand. The photograph illustrates this point (fig. 1).

Many other remedies have been used, such as balsam of Peru, β-naphthol, &c. None is universally satisfactory; some are too costly, others produce dermatitis, and for general use I do not think any plan superior to the one outlined, an old but a satisfactory method of treatment.

Experts are aware of the facts, but they are often overlooked by others, that many of the lesions of scabies still persist at the end of treatment, and that the remedy employed may itself occasion some slight degree of itching. Discovery of the acarus is the only absolutely certain proof that a man is still uncured. This test is useless when applied to the type met with in France, for the acarus is extraordinarily difficult to find, even in well-marked untreated cases.

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[1] Ungt. β-naphthol co., 2 oz., cost 2½d. Balsam of Peru, 2 oz., cost 1s. 2½d. Ungt. sulph., 2 oz., cost 1½d.

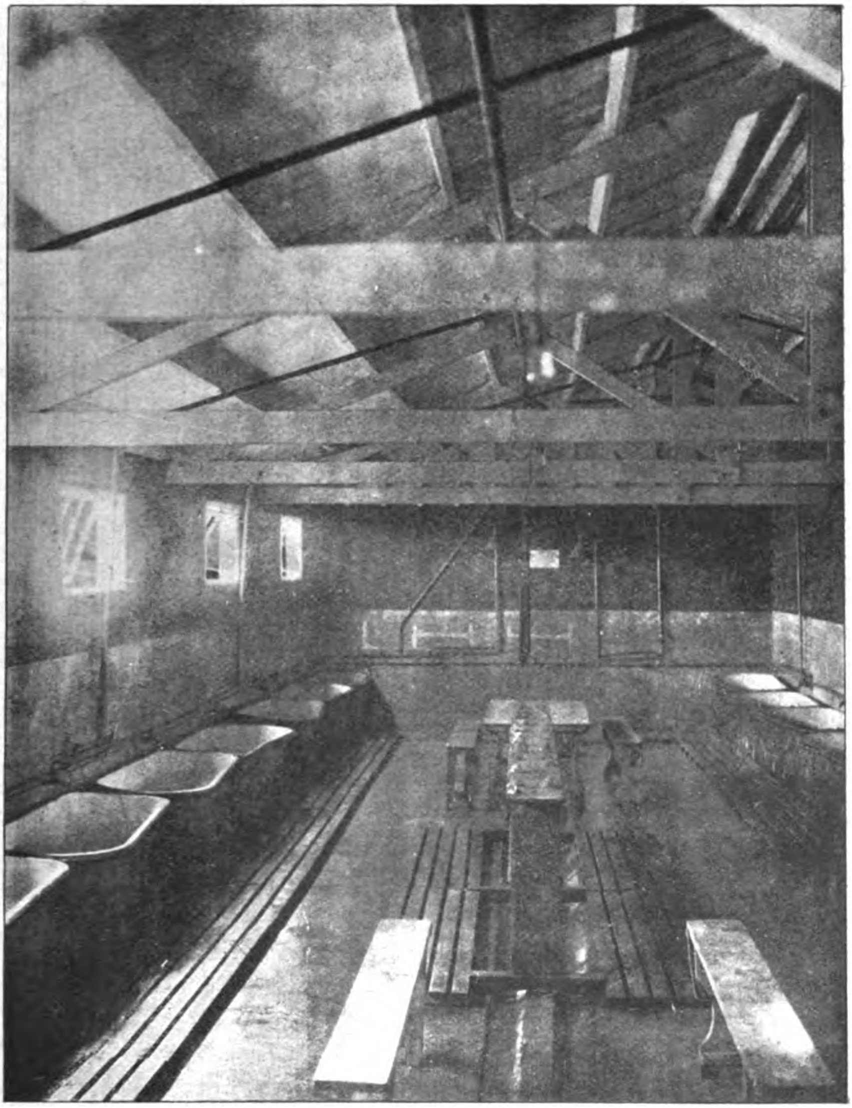

Fig. 1.—Treatment room for scabies.

If these facts were more widely known, cured men would not be returned to hospital for further treatment, as so frequently happens; and the practice of continuing the application of sulphur ointment, for days, or even weeks, under the mistaken idea of obtaining a more thorough cure, would cease.

Brief reference should be made to the impetigo associated with scabies. Its distribution on the buttocks (fig. 2) and frequently

FIG. 2.—Photograph illustrating characteristic buttock distribution of impetigo, secondary to scabies.

over the elbows and knees is very characteristic. This impetigo is of an ecthymatous type, and is caused by streptococcal infection; it is relatively common. Those unfamiliar with it are apt to overlook the primary scabies, which may be of slight degree. Its presence in no way contra-indicates sulphur treatment, which indeed often acts most beneficially. After the scabies has been cured, the same treatment is followed as for ecthyma elsewhere.

OTHER SKIN DISEASES.

Skin disease during war is not entirely made up of scabies and its complications; where large bodies of men are engaged it is natural to expect that other types, both common and rare, will be met

with; the two following tables show the admissions into hospitals A and B where I have worked. The high figure given for impetigo is somewhat misleading, since it includes impetiginization following scabies and seborrhœa. I do not suppose among the 5,000 odd cases there have been fifty instances of true impetigo contagiosa.

TABLE I.—ADMISSIONS TO HOSPITAL A.

	1915		1916						Total
	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	
Impetigo ...	122	172	151	161	220	170	147	116	1,259
Boils	24	59	50	51	42	36	65	48	375
Scabies	95	770	170	8	25	5	9	23	1,105
Dermatitis ...	7	10	10	11	11	8	8	7	72
Psoriasis ...	11	24	17	17	29	21	36	29	184
Seborrhœa ...	8	12	13	11	40	18	18	11	131
Eczema ...	7	22	18	11	37	22	33	31	181
Pediculosis ...	—	17	62	69	36	3	5	6	198
Erythema ...	3	7	5	—	4	1	—	1	21
Ecthyma ...	—	—	1	2	—	—	—	—	3
Pityriasis rosea ...	3	2	2	5	3	2	2	3	22
Folliculitis ...	1	11	13	9	8	2	5	1	50
Urticaria ...	2	4	3	3	2	11	8	1	34
Herpes zoster ...	2	2	2	—	3	3	1	—	13
Ichthyosis ...	—	—	1	—	—	—	—	1	2
Acne	6	22	19	12	8	6	10	7	90
Sycosis	4	2	4	1	3	2	5	7	28
V. D. S. ...	8	13	4	3	6	4	17	16	71
Carbuncle ...	2	4	3	1	4	2	1	2	19
Lichen planus ...	—	—	1	1	—	—	1	—	3
Sudamina ...	—	—	—	—	—	—	—	2	2
Erythema nodosum	—	—	—	—	—	—	—	2	2
Lupus	—	—	2	—	—	3	2	2	9
Erysipelas ...	—	—	—	—	1	--	1	2	4

The primary impetigo corresponds to an ecthyma, in the sense employed by Sabouraud—i.e., a dermic impetigo, of severe type and long duration. The legs and thighs are most frequently involved; sometimes the disease is very widespread, almost universal. The elementary lesion consists of an ulcer, often astonishingly deep, covered over by a thick black crust; if this be pressed upon pus can be freely squeezed out along the edges. A surrounding red halo marks the active extension of the process; indeed, when the crust has been removed a platinum loop can usually be passed under the skin for some distance, and this undermining makes treatment particularly difficult.

TABLE II.—ADMISSIONS TO HOSPITAL B.

	1916					1917			Total
	Aug.*	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	
Impetigo ...	268	729	849	388	305	287	444	655	3,925
Boils	129	258	396	116	85	62	130	168	1,344
Scabies	92	223	201	54	135	143	183	161	1,192
Dermatitis ...	21	91	92	54	44	42	67	61	472
Psoriasis ...	24	40	34	41	38	32	52	46	307
Seborrhœa ...	7	24	25	19	46	34	70	69	294
Eczema ...	22	69	83	41	48	52	62	76	453
Pediculosis ...	8	14	8	14	13	8	14	4	83
Erythema ..	—	3	2	8	2	5	1	1	22
Ecthyma ...	—	—	2	3	3	—	1	3	12
Pityriasis rosea ...	—	2	9	2	4	1	—	3	21
Folliculitis ...	—	1	1	—	1	2	1	2	8
Urticaria ...	8	9	11	15	5	6	5	2	56
Papular urticaria ...	2	—	—	1	—	2	—	—	5
Herpes zoster ...	11	20	19	6	2	3	8	8	77
Ichthyosis ...	—	—	—	4	1	3	5	3	16
Acne	4	10	11	6	7	5	9	7	59
Sycosis	3	11	5	3	4	10	5	9	50
V. D. S. ...	5	9	8	3	6	11	6	7	55
Carbuncle ...	22	26	43	6	1	—	1	6	105
Lichen planus ...	1	1	—	1	—	—	—	—	3
Sudamina ...	—	—	—	2	—	—	1	—	3
Lupus vulgaris and scrofulodermia ...	2	2	2	2	—	2	3	2	15
Erysipelas ...	—	—	2	—	—	—	—	—	2
Ringworm ...	4	1	1	1	3	5	5	5	25
Hyperidrosis ...	2	1	—	—	—	—	—	—	3
Hyperkeratosis—palm	1	—	—	—	—	1	—	—	2
Rosacea ...	1	—	—	—	—	1	—	—	2
Alopecia ...	—	—	1	—	—	—	1	—	2
Lupus erythematosus	—	—	—	1	—	—	1	—	2

* From August 9.

From the lesions it is possible to obtain a streptococcus, usually with ease, and, as might be expected, this is of the fæcalis type. Captain Henry, R.A.M.C., kindly examined strains from three different cases.

In Cases 26 and 28 two varieties of streptococci were found. Below are given their cultural characters :—

		Broth	Agar	Milk
26	Type A ...	Turbidity ...	Diffuse ...	A
	Type B ...	Flocculent ...	Diffuse ...	A and C
27	... ...	Turbidity ...	Diffuse ...	A and C
28	*a* ...	Turbidity ...	Diffuse ...	A and C
	b ...	Flocculent ...	Diffuse ...	A (and C)

On sugars, the following reactions were obtained (five days' growth) :—

	Saccharose	Lactose	Raffinose	Inulin	Mannite
26*a*	++	++	++	–	(+)
26*b*	++	++	+	–	++
27	++	++	–	–	+
28*a*	++	++	(+)	–	+
28*b*	++	++	(+)	–	++

These reactions correspond to the fæcalis type and exclude such forms as pneumococcus or pyogenes.

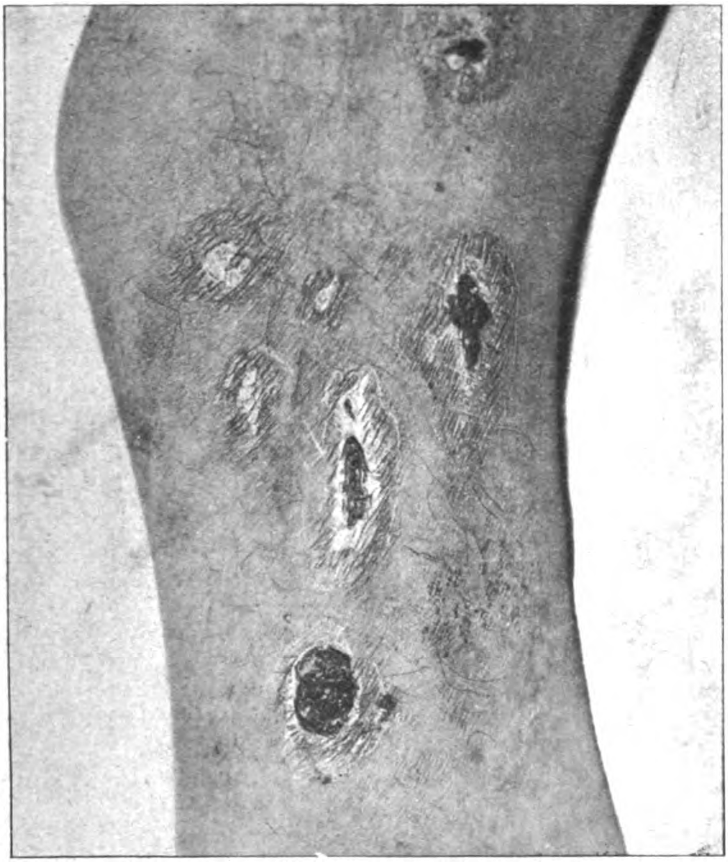

FIG. 3.—Ecthyma—active lesions and pigmented areas.

The following series of photographs illustrate fairly well the more typical forms of this primary ecthyma.

The first shows both active lesions and pigmentation about the knee. Onset six weeks before admission; another forty-one days in hospital were required to effect a cure (fig. 3).

The second illustrates the condition as met with on admission to hospital; the disease having been present fourteen days. Extensive crusted lesions are shown and the erythematous halo is visible around the more active sores. This man was cured after twenty-nine days in hospital (fig. 4).

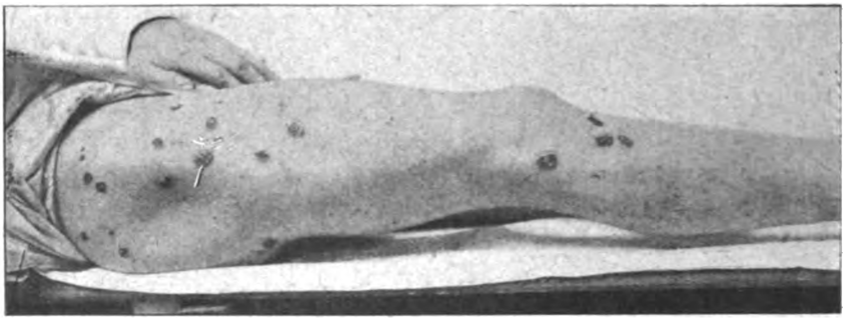

FIG. 4.—Ecthyma.

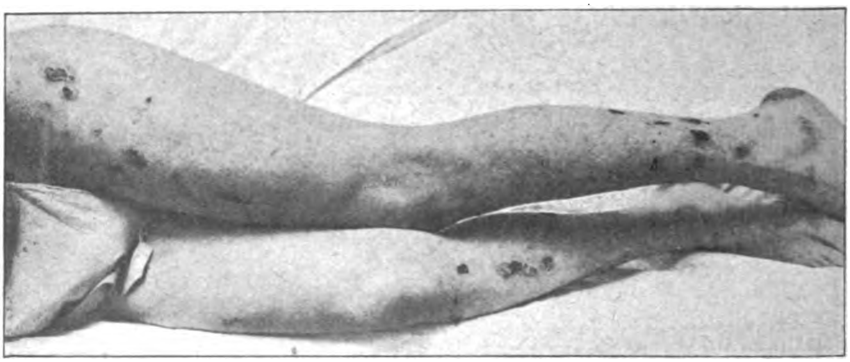

FIG. 5.—Ecthyma—uncured after sixty days in hospital.

The third case, although apparently similar to the previous one, shows how resistant the disease may sometimes be. The patient remained sixty days in hospital and was then evacuated to England, still uncured. The reason for the obstinacy of some cases I have been unable to determine (fig. 5).

In many cases marked pigmentation, and often scarring, are left behind. This is shown in the following photograph taken

when the disease had been present six weeks, and two weeks before complete cure (fig. 6).

Not infrequently the disease is followed by papillomatous or warty growths having a slight resemblance to verrucose tuberculosis; a photograph of this condition affecting the knuckle (fig. 7)

FIG. 6.—Ecthyma—late stage, showing pigmentation and scarring.

FIG. 7.—Warty condition following ecthyma.

and a painting of a similar lesion on the buttocks (Plate I) are shown. These growths may occur after any form of ecthyma, either primary or secondary to some other condition such as scabies, as in the painting. They are not uncommonly found on

the eyebrows, neck, or chin, following impetiginized seborrhœa in those situations.

The next three paintings serve to further illustrate the appearances of ecthyma. They show healing lesions with pigmentation (Plate II), a recent sore surrounded by an angry halo indicating progressive streptococcal undermining of the adjacent skin (Plate III) and an intermediate stage where the process has been arrested, the halo then fading to a dark purple-red colour (Plate IV).

The above series of photographs and paintings serve to indicate the course and aspect of primary ecthyma. Since it originates on the legs, and is associated with *Streptococcus fæcalis*, it is justifiable to assume that it begins by some slight abrasion or scratch becoming

FIG. 8.—Photograph showing result of attempt to imitate ecthyma.

infected with soil or water which has been contaminated with excrement. It would appear to be rare among troops fighting in the clean sand of the desert. Captain Barber, R.A.M.C., did not meet with such cases when in the East. Although it is to some degree increased by scratching, and the friction of garments, the disease is in no sense self-inflicted. One soldier made an attempt to copy it. He had been discharged cured of some other complaint, but, wishing to return to hospital, produced a condition seen in the next photograph; the fraud was obvious (fig. 8). Taxed with his fault, he confessed deception, and is now I hope distinguishing himself in another manner.

Treatment is difficult; healing is slow and tedious, and new

PLATE I.—Painting of buttock showing ecthyma, and one warty growth secondary to ecthyma.

Illustrating "Skin Diseases and their Treatment under War Conditions," by Major H. MACCORMAC, M.D., F.R.C.P., R.A.M.C.

PLATE II.—Ecthyma: healing lesions with commencing pigmentation.

Illustrating "Skin Diseases and their Treatment under War Conditions," by Major H. MacCormac, M.D., F.R.C.P., R.A.M.C.

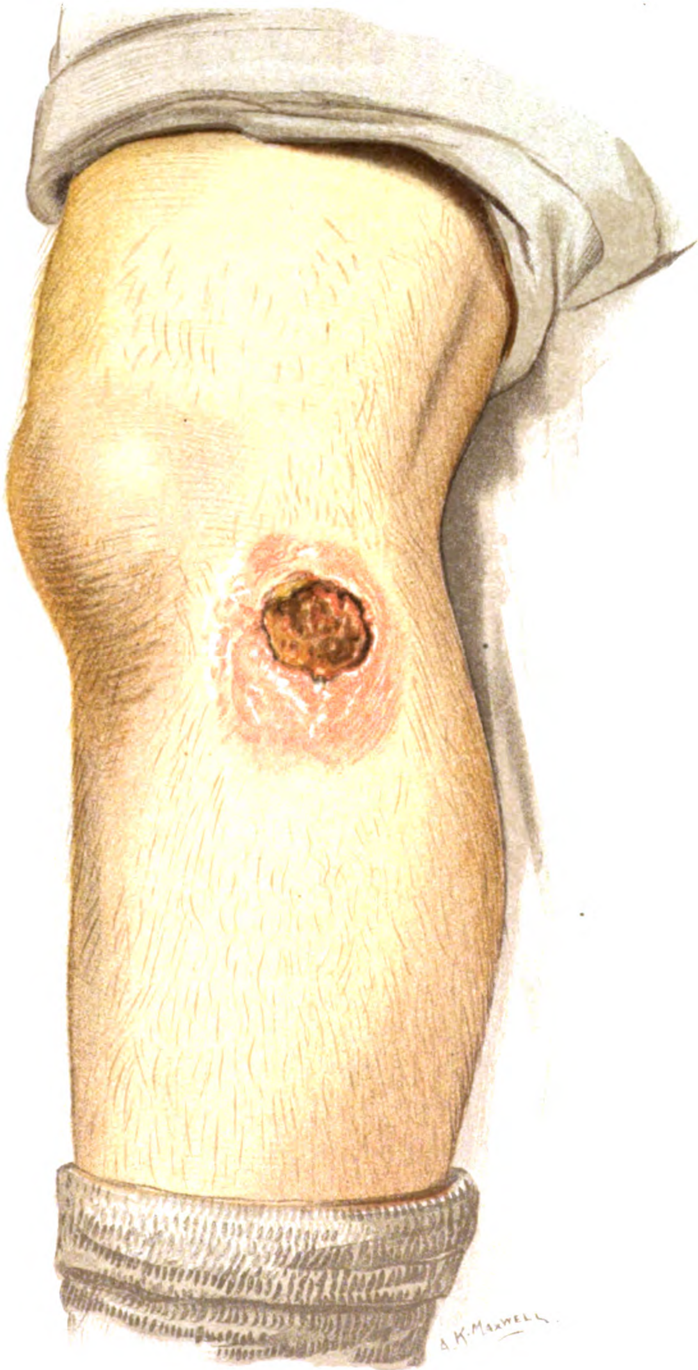

PLATE III.—Ecthyma: recent severe lesion.

Illustrating "Skin Diseases and their Treatment under War Conditions," by Major H. MACCORMAC, M.D., F.R.C.P., R.A.M.C.

Plate IV.—Healing ecthyma.

Illustrating "Skin Diseases and their Treatment under War Conditions," by Major H. MacCormac, M.D., F.R.C.P., R.A.M.C.

lesions appear in the most disappointing manner. The employment of fomentations is indicated at the beginning; they act, I suppose, by bringing up reinforcements of antibody—certainly at this stage no local antiseptic applications can affect the burrowing and undermining streptococci. Fomentations should be continued for a few days only and then perchloride dressings used so long as the skin will stand it. Recently I have found that painting with three per cent silver nitrate in sweet spirits of nitre has an extraordinary and in some cases almost specific action, either alone or in combination with the above treatment. Its action in coagulating albumin dries up the sores and in this way limits infection. I may add that I have tried both autogenous and stock streptococcal vaccines with little if any benefit.

FIG. 9.—Early linear impetigo.

The next type of impetigo, a linear variety, was independently noted both by Captain Small and myself before we became associated. It is fairly common, and characterized by the presence of longitudinal lesions. As in ordinary ecthyma the legs are chiefly affected. The earlier stage is represented by tiny lines of grouped blood-crusts; ulceration follows, the condition then pursuing a course similar to the ecthyma just described. The next three photographs (figs. 9, 10, and 11) illustrate pretty well the early and late appearances of this condition.

FIG. 10.—Linear impetigo—late stage.

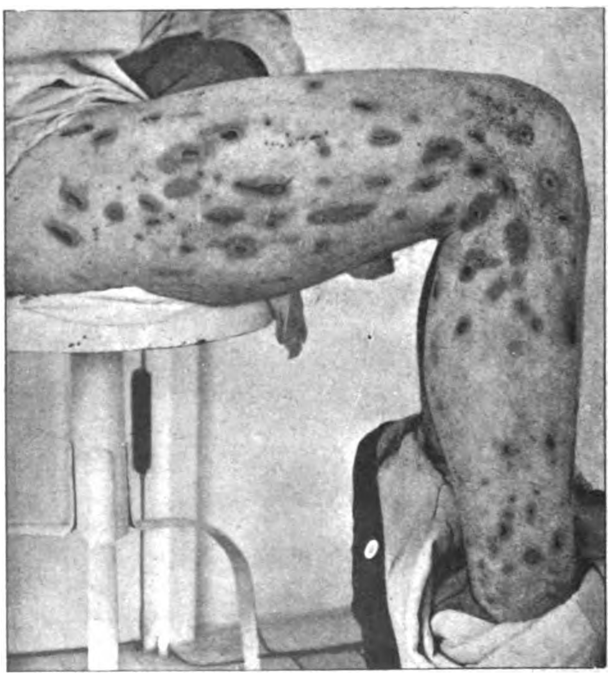

FIG. 11.—Linear impetigo—late stage.

The third photograph is of a patient who admitted to three similar attacks during nine months. The sensibility of the palate was considerably blunted, and this condition, associated with a slight degree of patchy anæsthesia of the legs, is fairly common in these cases. Too much stress should not be placed upon the palatal phenomenon, for I have found this change frequently present amongst soldiers who have been under fire for any length of time. Whether linear impetigo should be classified as an artefact or not, I am in doubt; its course and appearance closely correspond to such a condition, although its occurrence in males is contrary to the general rule; on the other hand, the war has occasioned types of neurosis unknown in civil life. I am inclined to consider this condition of linear impetigo as a combination of traumatism and secondary infection.

Seborrhœa.

The next important disease, seborrhœa, has given more trouble and proved more resistant to treatment than any other class of cutaneous affection met with in the Army. Since relapse is so frequent it would appear that many of these men are only fitted for employment in some special capacity. The following case is selected to illustrate the typical features and course of this complaint:—

Private D., aged 29; two years' service. Civil occupation, farm labourer. He states his scalp has always been scurfy. Present attack, the fifth, began two months before admission.

The scalp and body were affected to a considerable extent. This is shown in the accompanying diagram. On the head three phases could be distinguished—impetiginized areas on frontal regions and ears, eczematization of occiput, vertex and frontal regions; the rest of the scalp showed general dry seborrhœa and this was also present on the chest (back and front), shoulders, flexures of arms, pubis and thighs. I kept this patient in bed; he was put on a special diet with limitation of protein; he was dressed regularly. In spite of all this care, after he had been thirty-three days in hospital, so slow was progress that it was decided to send him to England; there he made a rapid recovery and will no doubt return to France, where in a short time the disease will break out again.

The diagnosis of seborrhœa is not always easy. When well marked, the characteristic distribution—scalp, eyebrows, beard, moustache—presents a picture easily recognized. The presternal

and interscapular regions are also frequently involved, and "eczema" of the flexures is always seborrhœic.

The disease tends to pass through three phases, any or all of which may be represented. First, a dry erythemato-squamous condition. Secondly, eczematization characterized by the presence of weeping surfaces, usually limited to the scalp. Thirdly, from contamination with streptococci, a condition of impetiginization.

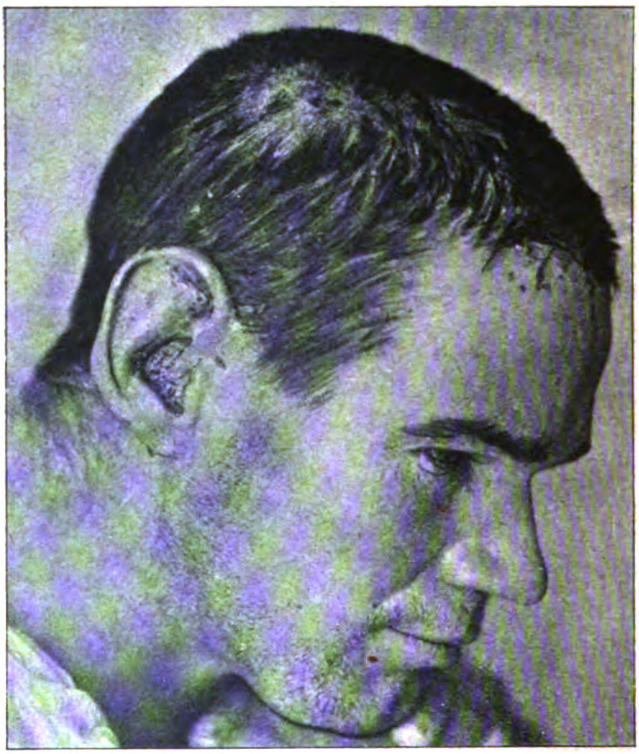

FIG. 12.—Impetiginized seborrhœa, chiefly affecting ears and scalp.

This last phase may cause considerable confusion, the purulent areas or "stuck on" crusts bearing a striking resemblance to impetigo contagiosa. I shall refer to this later.

The following series of photographs are selected as examples of the types of seborrhœa met with.

The first shows impetiginized seborrhœa of the scalp and ears, with dry seborrhœa of the chest. This man noted the onset three

weeks before admission. A streptococcus and *Staphylococcus albus* were obtained from the scalp by culture (fig. 12).

Typical cases are illustrated in three other photographs of this disease. Since the histories are similar to those described above, no detailed account need be given (figs. 13, 14, and 15).

These photographs illustrate how severe a disease seborrhœa may become under service conditions. Most striking is the susceptibility of the affected individual to secondary bacterial infections. Streptococci and staphylococci appear to be invariably present;

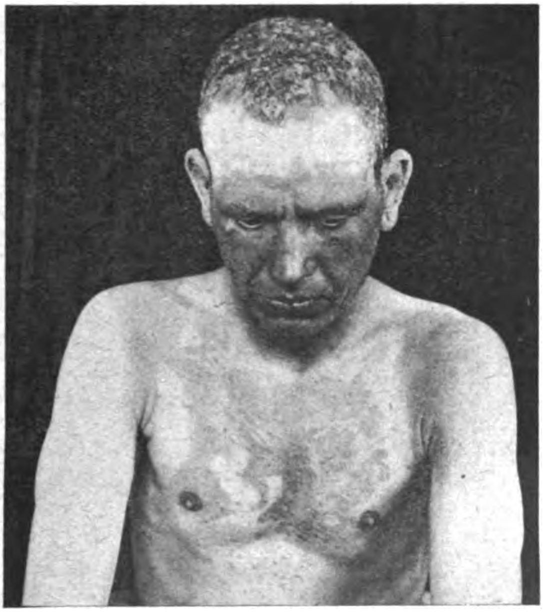

FIG. 13.—Impetiginized seborrhœa of scalp and "dry" seborrhœa of presternal area.

and a diphtheroid bacillus was found in five out of nineteen cases examined; morphologically it closely resembled the Klebs-Loeffler organism, even to the production of involution forms and beadings, but differed in its ability to ferment saccharose. It may only be a mere coincidence, but it is interesting to note that small epidemics of diphtheria were of common occurrence in the skin wards but in no other part of the hospital.

Among the nineteen cases examined, in three instances a curious Gram-negative coccus was detected both in culture and by direct

FIG. 14.—Impetiginized seborrhœa—eyebrows distinctly affected.

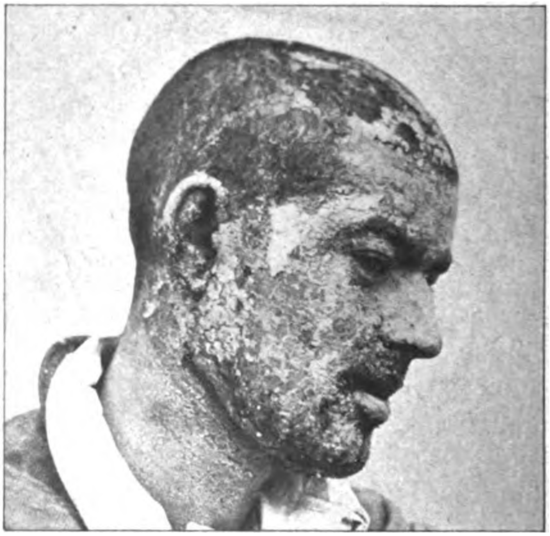

FIG. 15.—Severe impetiginized seborrhœa of scalp, face, &c.

examination. This organism fermented glucose, arabinose, and saccharose, and only grew at body temperature on agar.

In the light of these observations, it is not surprising to note that conjunctivitis, boils and impetiginization are such frequent complications of this disease. Sometimes a streptococcus plays a more serious rôle, producing severe adenitis of the neighbouring glands.

The resemblance of localized patches of this impetiginized seborrhœa to impetigo contagiosa is close and confusing. This is

Fig. 16.—Photograph illustrating resemblance of impetiginized seborrhœa to impetigo contagiosa.

particularly true when the ears alone are affected, for in such cases a secondary seborrhœa of the meatus is set up with purulent discharge. I show a photograph of this type; a correct diagnosis is easily made from the history, for in these cases the ear discharge follows the skin affection and does not precede it, as in impetigo contagiosa associated with otitis media.

The impetiginization may also be localized to the chin, or eyebrows; a photograph is shown illustrating this (fig. 16).

Treatment.

It is essential that the remedies employed in seborrhœa, especially the impetiginized form, should come into *intimate* contact

with the affected skin surface; for this reason when the disease attacks the scalp this region must be shaved as a preliminary measure. The same rule applies to the beard and moustache areas. Although secondary coccal affection with impetiginization is so regularly present as a complication, treatment should be directed against the eczematous condition; indeed, it has been found that antiseptics, no matter how mild, almost invariably aggravate the disease. In the early stages calamine liniment acts admirably; the mode of employment is important. After the preliminary shaving lint soaked in this substance is applied to the head and face; not only does it allay the disease, but as it is of an oily nature crusts are at the same time softened and removed. The ears require particular attention. After gentle syringing of the meatus with boric lotion, pledgets of wool soaked in the liniment are packed into all crevices; soaked wool is also moulded behind the ear in such a manner that the skin surfaces are kept apart. The whole area is then covered with dry wool and bandaged, thus "splinting" and preventing movement. Later more stimulating remedies may be cautiously tried.

On the body, weak sulphur ointment and strong perchloride lotion have proved satisfactory; treatment of the disease away from the face presents no difficulty.

The striking resemblance of this condition to impetigo contagiosa tempts medical officers to use mercurial ointments, with invariable failure. The rapidity with which calamine liniment effects improvement in these cases is astonishing.

General tonic treatment is indicated; practically all these patients complain of feeling ill, and many have told me that the disease breaks out after a preliminary few days of slight malaise. Most of them appear anæmic, and examination of the blood shows a slight degree of secondary anæmia. Two examples may be given:—

Serjt. R.: Red blood corpuscles, 4,200,000 per c.mm.; white blood corpuscles, 9,500 per c.mm.; hæmoglobin, 90 per cent.

Pte. B.: Red blood corpuscles, 4,526,000 per c.mm.; white blood corpuscles, 9,100 per c.mm.; hæmoglobin, 90 per cent.

The differential count shows no unusual features.

Other Varieties of Skin Disease.

A brief reference should be made to some of the other varieties of skin affections met with. During last summer pityriasis rosea

assumed almost epidemic proportions. The type was peculiarly extensive, even affecting the extremities and face, and was usually accompanied with glandular enlargements. It was frequently followed by multiple pityriasic areas, and this sequela in many cases prolonged the course considerably. In a few instances the disease assumed an unusually acute form, characterized by extensive erythemato-squamous areas of trunk and limbs closely resembling seborrhœa. The discovery of the characteristic ringed desquamation enabled a diagnosis to be made.

A curious papular urticaria appears to be fairly common; its distribution—anterior axillary folds and abdomen chiefly—together with the associated itching, produce a picture closely mimicking scabies. The course is different; it tends to subside spontaneously after a few days; relapse is frequent. Sometimes it may be associated with definite wheals which clearly point to its nature, and this observation was confirmed by a series of sections of the papules. It is not common in base hospitals, being more often found in those institutions where scabies is treated. Apart from its resemblance to scabies it is of no consequence.

As has been seen from the tables of admission, psoriasis accounted for 494 cases. The type met with was severe, almost invariably affecting the scalp. Chrysarobin proved most effectual in removing the disease from the body, and although extensively employed has occasioned no ill-effects. While obtainable resorcin was employed for the scalp; latterly salicylic acid has been used as a substitute.

Now, although psoriasis cannot be said as a rule to affect the soldier's health or prevent him from carrying out his duties, it is desirable to treat this disease for two reasons. In the first place, so long as it is present he has a ready excuse for "going sick." Secondly, his comrades imagine the disease is syphilis and resent his presence among them.

Although special hospitals are provided for the treatment of syphilis, 126 men with this disease have been received. These have been mainly tertiary or have presented unusual or difficult secondary manifestations. When non-contagious—that is to say tertiary—they have been kept. I do not think any harm results from this procedure. When late manifestations are found in the skin, I have never discovered the presence of nervous or vascular lesions, and I think the opinion held in many quarters may be accepted as a general rule that patients with skin gummata never

develop tabes, general paralysis of the insane, or aortic regurgitation. Of course, where the tongue is involved the outlook is entirely changed, and some form of intensive treatment should be adopted.

Before ending I should like to say a few words upon the organization of a skin hospital in France. Let it be remembered that a large part of the treatment has to be carried out by orderlies, unskilled in this particular work; that many of the sisters possess no special knowledge of skin diseases, although their general training enables them to become rapidly expert, and that the services of few dermatologists are available. Each medical officer has about 300 cases under his care, and about fifty cases are allotted to a sister and orderly, with additional help.

To meet these difficulties the hospital was divided into sections, to which special dressing and barbers' tents were allotted. The patients bring to these the medical officer's instructions written on special treatment forms; this is signed daily by the sister or orderly, thereby checking and ensuring regularity of attendance; otherwise some men are apt to neglect their dressings. Each medical officer pays a daily visit to his wards, but the work of diagnosis and prescription is carried out in a special hut. Here a man comes on arrival and returns at regular intervals, according to the needs of the case. This plan enables each medical officer to deal thoroughly with a large number of patients which would under any other system be difficult or impossible.

In the arrangement of all these things I have had the greatest help and consideration from the responsible authorities. Looking back on the early days when with two colleagues I sat shivering in a tent the sides of which had to be open to permit of a little light, with snow or rain descending upon us, I am more than thankful for things as they now exist. I remember with horror the well-meant but trying efforts of the orderlies to whom one ointment or lotion seemed as good as another. But all that is now changed. We have a staff of expert dermatologists, we have trained and expert orderlies, and the routine of the hospital proceeds in a regular and methodical way. The establishment of this special centre is, I believe, due to the foresight of the Director-General of Medical Services. Its results have already justified its existence.

It would be ungracious to conclude without expressing my gratitude to Colonel Copeland, my commanding officer. His

sympathetic assistance and advice have been of the greatest value. It is not everyone who is able to appreciate what may be done for men with skin complaints, and how considerable a number of them can be quickly returned to duty. They are not merely "uninteresting cases." There is not perhaps the glamour and excitement associated with their treatment that some appear to derive from attendance upon wounds. Surely they have suffered for their country as much as others; surely it is our duty as well as our privilege to give them of our best without stint and without reserve.

DIETETIC FALLACIES IN CONNEXION WITH GLYCOSURIA AND ALBUMINURIA.[1]

By Major HERBERT FRENCH, M.A., M.D.Oxon., F.R.C.P.Lond., L.D.

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The question of dietetics is always a very difficult one, but broadly speaking I think that practitioners divide themselves into two big groups upon the subject, one group being very strict, the other very lenient. Those of the strict group appear to me to assume that whatever a given patient eats is wrong in some way or other, so that this or that article of dietary must be altered or stopped; the lenient group, on the other hand, aims at allowing the patient as much lattitude as circumstances will permit as regards the kind of food and drink the patient takes, keeping a watch rather upon the amount taken and the circumstances under which meals are eaten than upon the kind of food.

One has but to think of the purin-free dietists, the vegetarians, and the tabloid dietarians, to realize the lengths to which dietetic fads can be carried, and doubtless there are some individuals who are in better health upon faddy diets than they are when they eat meals such as the ordinary evolution of mankind has shown to be reasonable. Every patient has to be taken on his or her merits in regard to dietary as in regard to other things, for personal idiosyncrasy is a very important factor which in clinical medicine can never be left out of count. It is useless for example to urge crab for those who always get urticaria afterwards, or strawberries for those unlucky individuals who cannot take them without itching and scratching for hours after them. Personally, however, I belong to what I would call the lenient school, for I hold that in most individuals who are not suffering from acute disease it matters much less what they eat than how much they eat, and when they eat. Moreover it is a favourite aphorism of mine—followed by good results in ever so many cases—that it is good for most of us to eat or do each day something which is theoretically bad for us, if only to be sure that one is still young enough to be able to do so.

[1] An Address read before The Connaught Hospital Medical Society.

To live along absolutely physiological lines seldom makes life happy; indeed some of the physiological dietists that I have seen, who weigh their foods and calculate their calories, are amongst the most miserable I have met.

I remember a case once in which a well-known physician was consulted by a lean, unhappy-looking man, who said he was constantly suffering from dyspepsia in spite of all the care he took with his diet. This man used to go home to his dinner in the middle of the day by train, because he could not get the food he thought he needed exactly right anywhere else but at home. His physician said to him, "The cure for you, sir, is to have for your mid-day dinner, each day for the next fortnight, three new buns, followed by a bottle of ginger beer, immediately after which you will run all the way to the station to catch the train." The real indigestion which this man got in consequence made him realize that his previous symptoms were almost as nothing and helped him to get out of his previous dietetic rut.

You will also remember the story of the man who tasted lobster for the first time and liked it very much, but suffered from such acute dyspepsia afterwards that he was awake all night in agony. Far from being a physiological dietist this man said: "My dear stomach, *you* may not like lobster but *I* do, and you have got to learn to deal with it"; so he went down to a seaside town and gave his stomach lobster each day for a week and presently found it quite obedient.

Feeling as I do that dietetic fads are bad for those who are not actually ill, it is easy to understand that I think equally little good of dietetic fads for those who are the subject of disease. That modification of the diet in ill-health is necessary is self-obvious. The man with pneumonia cannot eat beef-steak; the patient's own feelings by themselves limit the dietary when he is ill. We are not here this evening to discuss acute cases such as these, however, but certain chronic maladies in which it is the general habit to advise very strict dietaries, the two special ones I wish to say a word or two about being glycosuria and certain cases of albuminuria.

Turning to the question of dietetics in glycosuric cases first, I have been much impressed by the misery that is caused to many individuals who have been compelled by their doctors to eke out their dietaries with such wretched things as gluten bread and Soya bean biscuits, and things of that kind. I have often wondered whether it was worth their while; whether the strict dietetic treatment adopted actually lengthened their lives; and, even if the

lives were so lengthened, whether there was a larger amount of happiness in what remained after strict treatment was begun. Merely to prolong life and make that life unhappy cannot be a good criterion of successful treatment. The question arises whether the patients might not have lived as long or nearly as long and been very much more comfortable and happy if the dietetic treatment had not been so strict. The case which brought this most strongly home to me was one that I saw when not long qualified and newly started as a consulting physician.

The patient was a successful City man, aged 45, who, so far as he himself could tell, was in perfect health. Well nourished, active, vigorous, in the course of an ordinary examination for life insurance sugar was discovered in his urine in considerable amount. The discovery was a shock to himself and that was why he consulted a doctor to find out just where he stood. Beyond the abundant glycosuria he seemed physically sound. Fresh from books and full of theory, I told him all I thought then in regard to the things he must avoid in his dietary; and if he had followed my advice he would have been restricted to meals free from potatoes, bread, pastry, cakes, most puddings, and all visible sugar, and with some kind of special starch-free bread to take the place of ordinary bread. He listened to me until I had quite finished and then said: "Well doctor, your advice may all be very good, but I do not intend to follow it; I have indeed only one point that I want to ask you about particularly." I asked him what that was? He said: "Well doctor, what I what to know most of all is just how long you think I am going to live." Knowing that I could not answer this I asked him in reply why he wished to know; and then he explained. Having risen from a poor position to one of wealth he had purchased an old house down in Kent, and with the house went some capacious cellars that were well stocked with all kinds of wine from champagne to port. He was a man who knew how to enjoy life and what he wished to know was how long he still had upon this earth in order that he might divide up his supply of wines accordingly and make sure of finishing them before he died.

This is an extreme case of course, and doubtless the man ran great risks, but you will be interested to hear that without any treatment at all, and particularly no dietetic precautions, not only did he finish all the wine he then had in his cellars, but he re-stocked them and is still enjoying both his wine and his carbohydrate foods apparently no whit the worse for not having followed any of the dietetic advice that was my instinct then to give him.

If one had dieted this man I have no doubt but that one would have attributed his long survival to the treatment that had been adopted, but when survival occurred just as successfully with no treatment at all, one wonders whether there are not thousands of other cases in which the dietetic restrictions are really not responsible for the fact that the patient does not die soon.

I feel sure that it is a fallacious criterion to rely upon diminution in the amount of sugar passed as a measure of the improvement in the patient's condition. There is a great tendency to assume that any measures which cause the patient to pass less sugar in his urine are necessarily doing that patient good. I am far from holding this view, and indeed I think the amount of time and Fehling's solution expended in estimating the sugar in diabetic urines are often entire waste. From the point of view of glycosuria all cases may be divided, broadly speaking, into two main groups, namely those with acidosis products such as acetone, diacetic acid and oxybutyric acid in the urine, and those who pass sugar but no such acidosis products. The same patient may of course pass from one group to the other, the passage taking place either way; some patients come before one with both sugar and acidosis products who under treatment still pass sugar, but cease to pass acidosis products. Others present themselves with glycosuria but without acidosis products, and as the case progresses acidosis products begin to appear and the patient passes across the line from the relatively simple to the more serious category. When there is acidosis a very great deal more time and trouble is required to discover just what should be the dietetic restrictions which will minimize or possibly get rid of the acidosis tendency, though even here harm rather than good may be brought about by too strict an elimination of carbohydrate foods from the diet. No two cases are quite alike. Nobody really understands the nature of diabetes and nobody can lay down any *absolute* laws in regard to the dietetic treatment of the disease. One can, however, lay down certain *general* laws, and although I expect what I am about to say will evoke much criticism from this meeting, I feel sure that the effort on the part of the medical adviser should always be to discover not how much carbohydrate he can ingeniously eliminate from the patient's dietary, but rather how much carbohydrate he can enable his patient to take without developing dangerous acidosis. The amount of sugar passed in the urine is of very much less value as a guide in this direction than is a measure of the degree of acidosis, and personally I would very much rather rely upon laboratory estimations of the acidosis

products in guiding treatment, than I would upon the percentage or total grammes of sugar passed *per diem*.

The chemistry of the body is understood very much better than it was some years ago, but even now we are almost totally ignorant of the finer points of animal and vegetable chemistry, and whereas to most of us starch is starch, I am fully convinced that from a metabolic point of view one kind of starch differs very greatly from another. Wheat starch for instance seems to be quite different in its effects in diabetics to oatmeal starch, and both of these again differ from potato starch. These three at any rate I have tested repeatedly in this respect, and the probability is that there are equally marked differences in the way arrowroot, tapioca, sago, rice, and so on can be metabolized by those whose carbohydrate machinery is defective. The greatest offenders in diabetic cases appear to be wheat starch and ordinary sugar, and we owe a debt to von Noorden, who advocated the oatmeal treatment, and to Mosso, who suggested the potato treatment in diabetes.

One has seen cases who, upon full ordinary diet containing wheat bread and ordinary sugar, were doing badly with marked acidosis; it was clearly necessary to alter the regime. When wheat starch and sugar were removed from the dietary and perhaps opium or codeia prescribed, the sugar in the urine diminished considerably but the acidosis still persisted. I have even seen it get worse. In some such cases the prescribing of four ounces dry weight—of oatmeal, made up partly into porridge eaten with milk and salt, partly with oatcake eaten with butter and cheese, caused a very pronounced diminution in the degree of acidosis simultaneously with an increase in the total amount of sugar passed in the urine. The patient, previously somnolent and threatening to go into coma, has improved forthwith, and although when such a degree of acidosis has once developed it is rare to get rid of it completely, patients of this kind will often live for a considerable time, and much more happily when this carbohydrate is permitted than when a stricter regime as regards carbohydrate is being followed. I have always adopted the oatmeal cure more frequently than the potato cure, but I can quite believe that the allowance of two or three boiled potatoes of average size each day may often be thoroughly good for the patient instead of harmful.

The difficulty is to arrive quickly at some fair idea of how much carbohydrate should be allowed, and what form it should take. For those who are sufficiently wealthy there is no better way of finding this out than by sending them to be under the care of

Dr. Spriggs, at Duff House, Banff, N.B. Duff House is a very large establishment, the only one of its kind in Great Britain, I believe, devoted entirely to the investigation and treatment of various disorders of metabolism, including such things besides diabetes as obesity, undue thinness, gout, and so on. Complete analyses of all foods taken, of the urine, both for sugar and for acidosis and total nitrogen and ammonia, also of the fæces, are made daily by skilled chemists, and as a rule the course of investigation lasts about six weeks, during which time the condition of the patient upon ordinary full diet, upon greatly restricted diet, and upon various intermediate diets is carried out, and at the end of the time a report upon the most favourable dietary is sent to the doctor who is in charge of the case. The trouble is the expense, and naturally a great many patients are thereby precluded from the benefits of this ideal method of determining the best dietary. In private practice it is almost impossible to have sufficiently adequate analysis carried out, and therefore some much simpler criterion has to be adopted. As I have said above, mere estimations of the sugar are a bad criterion. It is, however, possible to test the effect of different dietaries by having the degree of acidosis estimated; and the next best simple means of testing the value of any particular dietary is the weighing of the patient periodically to make sure that he suffers from no undue loss of weight.

There appears to be little doubt, from recent researches, that whatever be the patient's ordinary tolerance for carbohydrate the adoption of periodic starvation days assists very materially in enabling the patient to deal with bigger quantities of carbohydrate than is otherwise the case. Here again, each patient has to have the best course discovered for himself, some cases requiring a starvation day once a week, others once a fortnight, others at longer and others at shorter periods. On the day of starvation it is as well that the patient should be at home and preferably he should stay in bed; he may drink as much water as he likes, and with the water he may be allowed during the day up to about two ounces of ordinary whisky; otherwise for that day he has no food at all, whether proteid, carbohydrate or fat. The next day he returns to such dietary as has already been found to suit him best, and as a rule he can metabolize larger quantities of carbohydrate in consequence of the temporary starvation treatment than he could without it. This does not, however, alter the general view I am endeavouring to express, namely, that it should be our aim to devise such dietary as is the most generous

possible as regards carbohydrate in the particular case, utilizing different forms of carbohydrate in the endeavour to find out that which suits the patient best, and gauging the effect less by the amount of sugar passed in the urine than by the concomitant degree of acidosis.

It may be urged that I should have made a differentiation between dietetic treatment of glycosuria in young people and the corresponding treatment of glycosuria in those past middle age. Clinically of course there is a very pronounced difference in the course the disease follows, and generally speaking no matter what one does for a patient with glycosuria at 20 years of age, with a urine of specific gravity 1040, and acidosis products in the urine as well as sugar when he first comes under observation, he will die in a comparatively short time. I agree that one needs to be a good deal stricter in the limitation of the carbohydrate food such a patient is allowed—but even then I have often wondered whether with all the usually severe restrictions as regards carbohydrate food, one prolongs life materially—in what one might call the average case; whilst I am certain that the patient is often and often heard to complain of the irksomeness of his food limitations. Moderate restriction even in the youthful diabetic seems to be quite as reasonable as is severe restriction; in either case the prognosis is bad and the question is which regime is likely to make the patient the least uncomfortable. In cases of glycosuria past middle life very slight restrictions in the carbohydrate dietary is often quite sufficient. When I say "sufficient" I do not mean that I base my views of the sufficiency on the getting rid of all sugar from the urine; I mean rather that the patient's life will not be very materially shortened by our being as generous as we can be with carbohydrate food; the fact of there being persistent glycosuria being more or less neglected provided that there is no concomitant acidosis.

Many authorities try to divide glycosuria up into various kinds such as alimentary, gouty, and so on, in addition to that which is on all hands regarded as true diabetes mellitus. Such a subdivision represents variations in the clinical variety of the disease, but not in my opinion a radical difference in kind.

To my mind the existence of glycosuria indicates that there is a temporary or permanent error of metabolism, which error of metabolism is not cured simply by diminishing the carbohydrate that the patient takes, even if this be done to a sufficient degree

to cause the urine to be sugar-free: the error of metabolism is not necessarily fatal within even a considerable number of years unless it reaches the degree of acidosis; even when it does this the length of the patient's life is not, in many cases, prolonged so much by the very strict dietetic measures formerly adopted as to make the discomforts associated with the restrictions themselves worth while.

Turning now to the other point that I wished to refer to here—namely, the question of dietetics in relation to albuminuria—I need not run over every condition that may produce albuminuria, but will restrict my remarks to two or three of them, in each of which I have found many doctors inclined to restrict the proteid dietary to a marked degree without in my opinion affording compensating advantages to the patient.

The first of these conditions is the so-called physiological or orthostatic, or adolescent albuminuria of young persons. There was a time when any form of albuminuria was regarded as so serious that anybody with albumin in the urine was rejected for life insurance purposes forthwith. It is now recognized, however, that many young persons, between the ages of 15 and 30 particularly, passed albumin intermittently in the urine without it being of any real significance. As throwing a great deal of light on the question of adolescent albuminaria I should like to refer to the researches carried out by Dr. William Collier upon university and college men; he examined the urines of large numbers of rowing men both before and after races, and he found it the rule rather than the exception for a rowing man, who might pass entirely non-albuminous urine before a race, to suffer from albuminuria immediately after it. This led to the curious *reductio ad absurdum* that a man who might have been passed as a first-class life for insurance purposes, say at three o'clock immediately before a race, would, under the old regime, have been rejected as uninsurable, say, at four o'clock after the race. The general rule with life insurance companies now, when albuminuria is found in a young man, such as one of the bank clerk age, is to have several specimens of urine tested, including at least one or two passed the first thing in the morning immediately after getting out of bed. Albuminuria of serious import in young people is nearly always constant; adolescent albuminuria, on the other hand, is marked by the fact that it is not present when the patient has been resting for some hours, becoming present later in the day. If therefore the patient has the albuminuria of adolescence it is probable that the urine

passed the first thing in the morning will be quite albumin-free, whilst that passed in the afternoon may contain albumin in abundance. In a minor degree it is the same kind of case as that of the rowing men I have just referred to. One would probably also examine a twenty-four hours' urine specimen for casts, blood or bacilli to make doubly sure. If the albumin is found to be absent in the morning and there is no microscopical evidence of any gross lesion in the urine tracts, the condition may nearly always be labelled one of unimportant albuminuria of adolescence, and even though the patient may pass albumin intermittently for years he will grow out of doing so in time. Some albuminuria requires no treatment at all, least of all dietetic treatment. There are some who advise young men of this kind to eat no meat; others seem to object to eggs in particular. The ground for this objection appears to be that egg albumen in animal experiments has been found to pass through the kidneys more readily than other forms of albumen, and the dietetic treatment is based upon what I believe to be the wrong hypothesis that if albuminuria of this kind has been found, it is essential to adopt such measures as will cause it not to be in the urine. Personally, I see no reason why it matters that the albumin does pass through in the kidneys of these healthy persons, and even though the eating of eggs may cause a more definite degree of intermittent albuminuria this has never appeared to me to be in the least detrimental to the patient's health, and my own advice in such a case would be that the albuminuria may be neglected altogether and the young man eat in moderation just such ordinary proteid meals as he would be allowed to if no albuminuria had been discovered.

Almost the same applies to a senile condition of albuminuria that is very common; doubtless when men aged 60 or 70, suffering from no enlargement of the prostate, and really from no very definite symptoms, begin to pass albumin in the urine, there is some degree of degeneration in the kidneys or in the arteries; that the patient is going to gain anything, however, by being entirely penalized from eating red meats for example, is very much open to doubt; if he is already in the habit of eating far more meat than is good for anyone, starting, as some people do perhaps, with beefsteak for breakfast, and having some kind of meat at every meal in the day, naturally curtailment is advisable, but I doubt whether the curtailment is any more to be insisted upon from the fact that there is slight albuminuria than it would be in any person who has such habits of proteid over-eating. Moderation is the key-note; to

taboo meat foods absolutely and entirely is not necessary, and should the patient miss the article that has been tabooed the treatment may be actually a mistake.

There is yet a third type of albuminuria that I would refer to in this connexion, and that is the relatively abundant albuminuria of persons suffering from what is generally referred to as chronic tubal nephritis. There has been an acute nephritis in the past, treated as skilfully as was possible, but unfortunately followed by a finite permanent damage to the renal tissue, so that there is considerable leakage of albumin into the urine persisting perhaps for many years before the patient either has an exacerbation of acute nephritis or develops heart failure or uræmia. Many such cases are met with when they still have years and years to live. During the stage when there is acute inflammation in the kidney marked restriction of the proteid dietary is certainly beneficial, and indeed in the acutest phase a purely milk dietary is the best. As time goes on, however, and the acute nephritis has subsided, there is left behind a damaged kidney in which there is no longer any inflammation. In the kind of case I am referring to the condition is no longer nephritis any more than mitral stenosis is endocarditis. Just as mitral stenosis is the unfortunate fibrotic after-effect of a previous endocarditis, so is the kidney I am trying to bring to your mind, a damaged organ no longer inflamed but injured as the result of having been the site of previous inflammation. One particular type of such kidney is what has been called the "Rose Bradford" kidney. The urine contains albumin in abundance every day; and the clinical evidence goes to show that Rose Bradford kidneys which may cause acute uræmia and death at say 20 years of age, may often be dated back to an attack of scarlet fever say at 5 years of age. The condition is almost sure to kill in time, but in quite a number of such cases one has found that the patient has lived a life almost exactly like that of other individuals both as regards dietary and everything else, until the final acute uræmia carried him off.

Seeing that upon such non-restricted lines the patient may live so many years, one has to ask oneself whether in other patients, in whom the albuminuria of the chronic tubal Bright's disease has been recognized by accident at an earlier stage, marked restriction of the proteid dietary on account of the existence of albuminuria has really prolonged life or made it happier. My own impression is that in such cases it is important to keep

the general nutrition up to at least as high a standard as is aimed at in healthy persons, and therefore that to restrict the dietary in any one particular should only be advised after very careful thought. To curtail the dietary by excluding red meats, and possibly other kinds of proteid, in my opinion may easily put the patient at a disadvantage, so that with his damaged kidneys in addition to his limited diet he is less able to withstand his illness than he would be if one had been more generous. Therefore in many such cases one allows the patient every form of proteid, not restricting him as to *kind* but only as to *amount*. Everyone would agree, I should think, that it would be most unwise to give a person with a damaged kidney more proteid than is the best amount for the maintenance of nitrogen balance and health. To let such a patient eat more meat than what might be called the average amount required for health would be unwise because of the unnecessary strain there would be to the kidneys in getting rid of the surplus. The amount of nitrogenous food partaken of does need watching, but the *kind* in my opinion is often attended to and limited to a degree which is not in the best interests of the patient. He has damaged kidneys, and as a result tends to poor health with anæmia and so on. Iron and a liberal selection of proteid foods, excluding not even sirloin of beef, will not be found to curtail the patient's life, provided always that the *amount* of proteid taken daily, whether in the form of fish, poultry, vegetable proteids, eggs, or butchers' meat, is the point to which moderate restriction is directed.

If a patient has a tuberculous kidney with active disease going on, there is probably albuminuria and pyuria, yet few people would hold that it would help the patient to get better if he were to become a vegetarian rather than to eat some meat each day. So in the case of other non-acute kidney lesions which are associated with albuminuria, it is well worthy of thought that it may be quite unwise to eliminate even butchers' meat from the dietary entirely even though the degree of albuminuria may be both persistent and considerable. Too much attention is often paid to the albuminuria itself without thinking of the general efficiency of the machine. Notwithstanding the existence of albuminuria the best dietetic treatment is often that which one arrives at by thinking of the treatment of the machine as a whole rather than of its localized renal defect.

REPORT UPON THE BACTERIOLOGICAL EXAMINATION OF ONE THOUSAND SOLDIERS CONVALESCENT FROM DISEASES OF THE DYSENTERY AND ENTERIC GROUPS.

By Captain WILLIAM FLETCHER,
Royal Army Medical Corps.
From the Laboratory of the University War Hospital, Southampton.

Several reports have been made, since the beginning of the war, upon the results of laboratory examinations made for the purpose of detecting and eliminating carriers of disease from amongst convalescent soldiers, but while most of these reports have dealt with the examination of men who had returned from the Eastern Mediterranean, the great majority of those who form the subject of this report had come from France.

The laboratory was equipped specially for work of this kind, so that I have been able to devote almost my whole time to it and to examine, myself, every plate made from the specimens brought to the laboratory.

In a short time every soldier will have received a prophylactic inoculation of paratyphoid vaccine. Nearly half the men, with the examination of whom this report is concerned, had been inoculated with a simple typhoid vaccine only, so that the results of this investigation may be useful for purposes of comparison.

In the first place, I wish to thank the officers of this hospital for the assistance which they have given me. I am greatly indebted to Surgeon-Major Lauder, the officer-in-charge, for constant help and encouragement. I am also indebted to my colleagues for allowing me free access to their wards, so that I was able to make a personal examination of any of the patients under their care. This was a great privilege and an advantage to all concerned. A pathologist is greatly handicapped when all he can learn of a patient is limited to the contents of a phial or a test-tube. Clinical pathology is too often clinical in name only.

The routine examinations of the patients' blood-serum was carried out by Miss Gertrude Long, with emulsions prepared at the Standard Laboratory, in the University of Oxford, and kindly supplied by Dr. Ainley Walker.

The patients who form the subject of these investigations were admitted to the University War Hospital, Southampton, between

the months of July, 1916, and April of the following year. Only 154 of the 1,000 men had come from the East, the rest from France. They were convalescent from various diseases. The following table shows the patients grouped according to the diagnosis on their transfer certificates or on other papers which they brought with them.

Typhoid	64
"Enteric"	102
Paratyphoid A	108
Paratyphoid B	205
"Paratyphoid"	15
"P.U.O."	2
Dysentery	504
	1,000

A short account will be given (1) of the methods adopted, and (2) of the value of brilliant green and of telluric acid for the purposes of enrichment. Subsequently the results of the examination of these men will be dealt with as follows:—

(3) Carriers of organisms of the Gaertner group:
- *B. paratyphosus* A.
- *B. paratyphosus* B.
- *B. aertrycke.*
- Anomalous organisms of the Samonella group.

(4) Carriers of organisms of the Eberth group:
- *B. typhosus.*
- *B. dysenteriæ* (Shiga).
- *B. dysenteriæ* (mannite-fermenting).

(5) Carriers of mixed bacillary infections.

(6) The vitality of the infecting organisms in the excreta of chronic carriers.

(7) The treatment of chronic carriers.

(8) Summary and conclusions.

I.—Methods Employed.

At first, samples of fæces were sent to the laboratory on swabs, such as are used in connexion with the diagnosis of diphtheria. This method is unsatisfactory and was abandoned, after about a hundred cases had been examined.

Samples from the next 500 cases were collected in large, six-inch, Petri dishes. The advantages of this method were: Firstly, there was no danger of the stool becoming contaminated before being brought to the laboratory, as it could be passed directly into the dish; secondly, the stool could be readily inspected. The

danger of contamination is a very real one and may give rise to an immense amount of unnecessary work, as the following incident shows:—

On August 12, 1916, *Bacillus paratyphosus* B was isolated from fourteen out of seventeen samples of fæces sent for examination. After a great deal of trouble, it was determined that none of the seventeen men was, himself, a carrier, but that they all used the same water-closet as a chronic carrier of *B. paratyphosus* B, through whose agency the samples had probably become infected. Harvey (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, June, 1915) relates a similar experience.

The drawback to the use of the large Petri dishes is that they are dirty to work with, and unpleasant to handle in the laboratory. Glass vaseline pots, with screw-on metal tops, were then obtained, and for the purpose of collecting the sample, a piece of stout wire, twisted so as to form a loop at one end, was placed in each of the pots. These pots were clean to handle and, as they could be sterilized in the autoclave without breaking, they were found very useful. They were cheap (13s. a gross), and the screw-tops on which the patients' names could be written with a lead pencil were most convenient.

For the examination of 300 of the cases three types of special media were used in the preparation of the plates; MacConkey's neutral-red-bile-salt-lactose-agar, litmus-lactose-agar and Endo's fuchsin-sulphite-agar. The best results were obtained with the latter; even in cases of dysentery, the "positive" colonies were larger on Endo's medium than on the litmus-lactose-agar unless they were in pure culture.

The urine was collected, throughout, in large sterile test-tubes. It was incubated for twenty-four hours at 37° C., and then plated on Endo's fuchsin-sulphite agar. The urine of several carriers was plated both before and after incubation, with the result that the plates spread before incubation were sterile on some occasions when pathogenic organisms were isolated from the plates spread afterwards; thus demonstrating the necessity of preliminary incubation.

The samples of fæces were examined as follows:—

About one gramme of fæces was taken up on the end of a piece of florist's wire and emulsified in a tube of sterile salt-solution, by twirling the wire between the finger and thumb. This emulsion was allowed to settle for one hour, after which two platinum loopfuls were spread on a plate of Endo's medium, and two loopfuls

were also put into a tube of brilliant-green medium (0·5 cubic centimetre of a one per cent solution of brilliant-green in a litre of peptone water, tubed and autoclaved), which was incubated at 37° C. for twenty-four hours.

On the following day, the plate spread direct from the fæcal emulsion was examined, and one loopful from the incubated, brilliant-green tube was spread on a plate of Endo's medium, which was then incubated at 37° C., and examined after twenty-four hours.

The plates were examined with the help of a hand-lens (x 10); a method which enables one to exclude many a colony which appears promising to the naked eye.

The likely colonies were tested with a pooled "Gaertner serum," containing paratyphoid, aertrycke and enteritidis specific serums, and with a similar "Eberth serum," consisting of a mixture of typhoid and dysentery serums. The testing was carried out by emulsifying part of the colony in a drop of the serum with a platinum wire, on a slide, and examining for the occurrence of agglutination with a hand-lens. Those colonies which agglutinated, and any others which, though they did not agglutinate, were yet suspiciously like "positive" colonies in appearance, were sub-cultured on agar-slopes.

On the next day, the agglutination titre of the culture under examination was determined by means of specific serums and the following media were inoculated: Peptone-water, gelatine, litmus-milk, lactose, saccharose, glucose, maltose, mannite, dextrine and dulcite. The condition of each tube of medium was noted daily on a temperature chart. The culture in peptone-water was examined for motility after eighteen hours and it was tested repeatedly for indol, during a period of fourteen days, in the following manner: About 0·5 cubic centimetre of the peptone-water was taken up in a capillary pipette, put into a Durham's tube with a rather wide bore, and to this a similar quantity of benzaldehyde solution was added. In all cases where indol was present, a red ring appeared at the junction of the two fluids, without the addition of potassium persulphate.

The agglutinating power of the patient's own serum, upon the bacillus cultivated from his excreta, was then tested and, finally, saturation tests were applied to emulsions of the organisms isolated, by the method to be described in connexion with *B. paratyphosus* A.

The agglutination reactions of the pathogenic organisms, which were isolated, were studied by means of Wright's capillary pipettes.

The pipettes, containing the various dilutions of serum mixed with living bacterial emulsion, were incubated at 37° C. for two hours and the readings taken at the end of that time.

The determination of the agglutinin content of the patient's blood-serum was carried out, in every instance, by the method recommended by Professor Dreyer, with apparatus kindly supplied by the Medical Research Committee.

II.—The Value of Brilliant-Green Enrichment.

Such different results have been reported from the use of brilliant-green enrichment in the examination of convalescents from dysentery and diseases of the enteric group, that it does not seem out of place to record the results of its employment for the purpose of detecting carriers in this hospital. For the investigation of the many thousands of specimens examined it was impossible to employ the five tubes recommended by Browning, so that, in each case, a single tube was employed containing 0·05 per cent. of a 1 in 100 watery solution of brilliant-green in peptone water. This medium was made up in bulk, tubed, and sterilized in the autoclave.

The technique employed was as follows :—

About 0·5 gramme of the specimen of fæces was taken up on a piece of sterile florists' wire with a hook at one end 0·5 centimetre in diameter. The fæces were transferred, in this loop, to a tube containing five cubic centimetres of salt solution and were emulsified therein by twirling the end of the wire between the finger and thumb. The emulsion was allowed to settle for one hour, after which two platinum loopfuls were inoculated into ten cubic centimetres of the brilliant-green solution and, as a control, two more loopfuls were plated direct from the emulsion on to Endo's fuchsin-sulphite-agar.

The inoculated tube of brilliant-green was incubated at 37° C. for twenty-four hours; one platinum loopful was spread on a plate of Endo's medium.

For the first 200 cases investigated, brilliant-green enrichment, alone, was employed; for the next 800, both direct plating and brilliant-green enrichment were used in the examination of every sample of fæces. This is a most necessary precaution in the examination of men who are convalescent from various infectious diseases of the alimentary system; for it may be said, at once, that while brilliant-green is of the greatest assistance in detecting carriers of the Gaertner group of organisms, its use, uncontrolled

by direct plating, actually prevents the discovery of carriers of the Eberth group.

It will be best, therefore, to consider, separately, the results obtained in the isolation of the different members of the Gaertner and of the Eberth groups.

(*a*) *Results of the Use of Brilliant-green in the Isolation of Organisms of the Gaertner Group.*

B. paratyphosus B.—The following table shows the results of direct plating compared with plating after enrichment with brilliant-green, in the examination of nine carriers whose fæces contained *B. paratyphosus* B in small numbers.

Forty-nine specimens of the fæces of these men were found to contain paratyphoid bacilli. In six instances the infection of the sample was detected both by the direct and by the brilliant-green methods, but, from forty-three samples, the organisms were isolated by brilliant-green enrichment alone, while direct plating failed to demonstrate them.

It will be seen from the table that five of these nine carriers would have escaped detection if direct plating had been employed alone :—

TABLE SHOWING THE VALUE OF BRILLIANT-GREEN FOR THE ISOLATION OF *B. paratyphosus* B IN LIGHT INFECTIONS.

Case number	Number of times isolated by direct plating	Number of times isolated by brilliant-green
314	0	2
282	0	1
360	1	1
581	3	24
588	0	1
702	0	7
734	0	1
842	1	7
1,058	1	5
Total	6	49

In the following table are shown the results in Case No. 581, where the fæces were often infected lightly with paratyphoid bacilli. A positive sign indicates that *B. paratyphosus* B was isolated.

CASE 581.

AN EXAMPLE OF THE ADVANTAGES OF BRILLIANT-GREEN IN THE ISOLATION OF *B. paratyphosus* B FROM THE FÆCES.

Date	Results of direct plating	Results of brilliant-green enrichment	Date	Results of direct plating	Results of brilliant-green enrichment
Dec. 8 ..	0	+	Jan. 22 ..	0	+
15 ..	+	+	25 ..	0	+
19 ..	0	+	26 ..	0	0
23 ..	+	+	29 ..	0	+
26 ..	0	0	30 ..	0	0
28 ..	0	0	31 ..	0	+
30 ..	0	0	Feb. 2 ..	0	0
Jan. 2 ..	0	+	3 ..	0	0
3 ..	0	0	5 ..	0	+
4 ..	0	+	6 ..	0	0
5 ..	0	+	7 ..	0	0
8 ..	0	+	10 ..	0	0
10 ..	0	+	13 ..	0	0
11 ..	0	0	14 ..	0	0
12 ..	0	0	15 ..	0	0
13 ..	0	0	22 ..	0	+
14 ..	0	+	28 ..	+	+
17 ..	0	+	Mar. 1 ..	0	+
18 ..	0	0	6 ..	0	+
19 ..	0	+	7 ..	0	0
20 ..	0	+	9 ..	0	+

When the infection of the fæces is very abundant, paratyphoid bacilli are, of course, isolated by the direct method as well as by brilliant-green enrichment. In one case (No. 666) *B. paratyphosus* was recovered by both methods on every occasion, in the examination of 104 specimens of the carrier's fæces. Similarly, in another case (No. 999), the organism was isolated constantly by both methods in the examination of twenty-three specimens.

During the examination of 800 cases both by direct plating on to Endo's medium, and by brilliant-green enrichment, *B. paratyphosus* B was isolated from several hundred samples of fæces, but while the organism was found with the help of brilliant-green when direct plating failed, in no instance did the reverse occur.

In the examination of those specimens from which the organisms can be cultivated by both methods, the percentage of paratyphoid colonies on the Endo plate is much greater after preliminary brilliant-green enrichment. The following results of the examination of the fæces of Case No. 699 are an illustration of this. The percentages are not accurate, they were calculated roughly, but they give a better idea of the proportion of positive colonies than "many," "very many," etc. The occasions on which the organism

was recovered by brilliant-green alone have been omitted from this table.

CASE 699.

ILLUSTRATING THE INCREASED PROPORTION OF PARATYPHOID COLONIES AFTER BRILLIANT-GREEN ENRICHMENT.

Date of specimen	Percentage of paratyphoid colonies on Endo plate after: Direct plating	Previous brilliant-green enrichment
January 24	2	100
,, 27	10	100
February 2	15	100

When the infecting organisms are gradually disappearing from the fæces, they can be isolated for a longer period by the brilliant-green method. An emulsion, in salt solution, was made of a sample of the fæces of a chronic carrier (No. 666) which was very rich in paratyphoid bacilli. The emulsion was kept at room-temperature, about 15° C., and was examined daily by both methods. *B. paratyphosus* B was isolated every time by brilliant-green enrichment, until the tube was accidentally broken on the forty-first day. By direct plating, on the other hand, the organisms were not recovered regularly after the tenth day; during the last thirty-one days they were isolated only nine times.

Many more examples could be given, but the evidence in favour of brilliant-green enrichment for the isolation of *B. paratyphosus* B is overwhelming.

B. paratyphosus A.—Four fæcal carriers of *B. paratyphosus* A were found among the 800 convalescents whose excreta were examined both by direct plating and by preliminary enrichment with brilliant-green.

One (No. 656) was a temporary carrier. In his case direct plating failed, but paratyphoid bacilli were isolated by the enrichment method.

The other three cases were chronic carriers. In two of them, Nos. 666 and 782, *B. paratyphosus* A was present in enormous numbers, and was found by both methods at almost every examination. Paratyphoid bacilli were not so abundant in the fourth case, No. 776, and in the course of the examination of twenty-seven samples of his fæces, paratyphoid bacilli were isolated twenty-two times by brilliant-green enrichment, but only on six occasions by direct plating.

The following table shows the results obtained by the use of the two methods in this case:—

CASE 776.

COMPARISON OF DIRECT PLATING AND OF BRILLIANT-GREEN ENRICHMENT IN THE INVESTIGATION OF A CARRIER OF *B. paratyphosus* A.

Date	Percentage of paratyphoid colonies after: Direct plating	Percentage of paratyphoid colonies after: Brilliant-green enrichment	Date	Percentage of paratyphoid colonies after: Direct plating	Percentage of paratyphoid colonies after: Brilliant-green enrichment
Jan. 23 ..	0	100	Feb. 10 ..	0	100
24 ..	3	100	12 ..	0	90
26 ..	0	100	13 ..	0	100
27 ..	0	100	14 ..	0	0
29 ..	0	100	15 ..	0	100
30 ..	50	100	16 ..	0	100
31 ..	0	80	17 ..	0	100
Feb. 1 ..	0	100	19 ..	1	100
2 ..	40	100	20 ..	0	100
5 ..	0	0	21 ..	0	0
6 ..	0	100	22 ..	0	100
7 ..	0	100	23 ..	1	70
8 ..	0	0	24 ..	0	95
9 ..	3	100			

When *B. paratyphosus* A is gradually disappearing from the fæces, day by day, the infective organisms are isolated for a longer period by brilliant-green enrichment than by direct plating. As mentioned before, enormous numbers of *B. paratyphosus* A were present in the fæces of two of the chronic carriers. One of these two was No. 782. In every specimen of this man's fæces, the bacilli were so abundant that they were isolated at each one of nineteen examinations made by the brilliant-green method, and eighteen times by direct plating. An emulsion of his fæces was made in a tube of sterile salt-solution, which was kept at about 15° C. Every day this emulsion was examined both by direct plating and by the brilliant-green method. *B. paratyphosus* A was not isolated by dirct plating after the ninth day, but it was found by brilliant-green enrichment as late as the thirty-eighth day.

From the above evidence, one must conclude that the brilliant-green method is as efficient in the isolation of *B. paratyphosus* A as it is in the isolation of *B. paratyphosus* B.

B. aertrycke.—This bacillus was isolated from the fæces once only (No. 359). On that occasion direct plating failed to demonstrate its presence, but it was obtained, in almost pure culture, on the Endo plate spread from the brilliant-green enrichment medium.

B. enteritidis (Gaertner) was not isolated by either method from any of the excreta examined.

Anomalous Organisms of the Salmonella Group.—Brilliant-green enrichment was as favourable to the isolation of these strains as it was in the case of true paratyphoid organisms.

(*b*) *Results of the Use of Brilliant-Green in the Isolation of Organisms of the Eberth Group.*

B. typhosus.—*B. typhosus* was isolated from the fæces of three men (Nos. 264, 291, 301). In each instance the bacillus was recovered from the plate of Endo's medium inoculated directly with an emulsion of the fæces. No typhoid bacilli were isolated, in any case, by brilliant-green enrichment. Each of the three cases was subsequently examined by the five-tube method (five tubes employed containing, severally, 0·1 cubic centimetre, 0·2 cubic centimetre, 0·35 cubic centimetre, 0·5 cubic centimetre, and 0·7 cubic centimetre of 1/10,000 brilliant-green in each tube of 10 cubic centimetres peptone water, as recommended by Browning) but in no case were typhoid bacilli found. Telluric acid was not available at the time these men were examined; without it, the brilliant-green method did not appear to be of assistance in the isolation of the typhoid bacillus from the fæces, but rather to inhibit its growth.

B. dysenteriæ.—There was not a single instance, during the examination of 1,000 convalescents, of the isolation of dysentery organisms by the brilliant-green method, but by direct plating of the fæces on to Endo's medium dysentery bacilli, of the mannite-fermenting group, were isolated from eighteen patients and *B. dysenteriæ* (Shiga) from one.

In two of the eighteen cases mentioned above, paratyphoid as well as dysentery bacilli were found in the patients' fæces. As shown in the following table, the dysentery bacilli were isolated by direct plating, the paratyphoid by brilliant-green enrichment. Dysentery bacilli were not isolated from a single specimen by the brilliant-green method, and in only one instance were paratyphoid bacilli isolated by direct plating from the excreta of these two men.

The results of the examination of these two cases, as set out below, show in unmistakable fashion the value of brilliant-green in the isolation of paratyphoid organisms and its inhibitory action upon *B. dysenteriæ*.

As the result of these observations one must conclude that it is necessary to employ both methods for the examination of convalescents from diseases of the dysentery and enteric groups. Direct plating is necessary for the isolation of organisms belonging

CASE 702.

SHOWING THE INHIBITORY EFFECT OF BRILLIANT-GREEN UPON DYSENTERY BACILLI OF THE MANNITE-FERMENTING GROUP, AND ITS ENRICHING EFFECT UPON PARATYPHOID ORGANISMS.

Date of specimen	Type and approximate percentage of pathogenic organisms found on plate: Direct plating		Brilliant-green enrichment	
Jan. 10	*B. dysenteriæ*	50	.. ..	0
13	,,	5	*B. paratyphosus* B	40
17	,,	0	,,	100
19	,,	20	,,	100
20	,,	10	,,	100
22	,,	5	,,	100
23	,,	0	,,	100
26	,,	0	,,	100

CASE 886.

SHOWING THE INHIBITORY EFFECT OF BRILLIANT-GREEN UPON DYSENTERY BACILLI OF THE SHIGA TYPE, AND ITS ENRICHING EFFECT UPON PARATYPHOID ORGANISMS.

Date of specimen	Type and approximate percentage of pathogenic organisms found on plate: Direct plating		Brilliant-green enrichment	
April 2	*B. dysenteriæ* (Shiga)	70	.. ..	0
3	,, ,,	80	.. ..	0
4	,, ,,	90	.. ..	0
5	,, ,,	90	.. ..	0
7	,, ,,	100	.. ..	0
9	,, ,,	30	.. ..	0
10	,, ,,	40	.. ..	0
11	,, ,,	40	.. ..	0
12	,, ,,	20	.. ..	0
13	,, ,,	60	.. ..	0
14	*B. dysenteriæ* *B. paratyphosus* B	30 30	*B. paratyphosus* B	60
16	.. .. ..	0	,, ,, ,,	3
17	*B. dysenteriæ* (Shiga)	1	.. ..	0
18	.. .. ..	0	*B. paratyphosus* B	1
19	*B. dysenteriæ* (Shiga)	1	,, ,, ,,	0
20	,, ,,	100	,, ,, ,,	0

to the Eberth group, and brilliant-green enrichment for those of the Gaertner group. If direct plating be used alone, paratyphoid infections will be missed which would be detected by brilliant-green enrichment. If the brilliant-green method be employed alone, then carriers of typhoid and dysentery bacilli will be overlooked.

The Value of the Addition of Telluric Acid to the Brilliant-green Enrichment Medium.—When telluric acid became available there were no carriers of *B. typhosus* in the hospital, so that it was not possible to test its value in the isolation of that organism by Browning's method, but the isolation of paratyphoid and dysentery bacilli were attempted by its use.

The enriching medium contained 0·5 cubic centimetre of brilliant-green (1/100 solution), and 4 cubic centimetres of telluric acid (1/100 solution), in a litre of peptone water. The same medium

without the addition of telluric acid, and also direct plating, were employed as controls.

The specimens of fæces which were sent in daily, from three men who were carriers respectively of *B. dysenteriæ* (Shiga), (No. 886), *B. paratyphosus* A and B (No. 666) and *B. paratyphosus* B (No. 999), were emulsified in salt-solution, about one gramme of fæces being added to ten cubic centimetres of salt solution. After the emulsion had stood for an hour, two platinum loopfuls were plated on Endo's medium, two loopfuls were put into brilliant-green and two into the medium containing brilliant-green and telluric acid.

As the tubes containing the telluric acid were nearly always sterile after twenty-four hours' incubation, it was thought probable that too small a quantity of the fæcal emulsion was being used, so that, after the first four examinations, eight loopfuls were added to the telluric acid tubes instead of two.

The results obtained by using the increased quantity were no better than before, so that, after a further series of four samples of fæces from each case had been examined, the amount emulsified in the telluric acid medium was increased to half a gramme. The results were still far inferior to those obtained by the use of brilliant-green without the addition of telluric acid.

Dysentery organisms were never isolated from the fæces, either by brilliant-green or by telluric acid enrichment.

The fæces of the carrier of *B. paratyphosus* B (No. 999), mentioned above, were examined twelve times by the telluric acid method. On four occasions two loopfuls of fæcal emulsion were added; on four, eight loopfuls were added; finally, on four further occasions 0·5 gramme of fæces was added to the tube of telluric acid medium. From the brilliant-green medium, which did not contain telluric acid, paratyphoid organisms were isolated from every one of the twelve samples, in pure culture, but from the telluric acid they were isolated only twice and then not in pure culture.

Sixteen examinations were made in the same way of the fæces of a carrier of a mixed infection of paratyphoid of both the A and B types (No. 666). In the last eight of the sixteen examinations, 0·5 gramme of fæces was put into the telluric acid medium. Paratyphoid bacilli of both types were isolated from the brilliant-green tubes on every occasion, but only three times from those which contained telluric acid.

It is clear that the telluric acid employed had an inhibitory effect upon the growth of paratyphoid organisms.

Two samples of telluric acid were obtained. One sample did not dissolve readily in water to form a one per cent solution; the other was much whiter and cleaner, in the dry state, and dissolved readily.

One per cent solutions of the two samples were prepared and titrated with $\frac{N}{10}$ sodium hydrate. One hundred cubic centimetres of a solution of the first sample were neutralized by thirty-eight cubic centimetres of the soda solution, while the same quantity of the second sample required forty-two cubic centimetres.

It may be that the discordant results obtained by various workers who have employed telluric acid are to be ascribed to differences in the samples of the acid they have severally employed.

Those samples which were tested in this laboratory inhibit strongly the growth of paratyphoid and dysentery organisms in fæcal emulsions.

III.—Carriers of Infections of the Gaertner Group.

Carriers of B. paratyphosus A.

B. paratyphosus A was isolated from the excreta of six cases, all of whom, with one exception (No. 656), had been in the East. Organisms belonging to the group known as "pseudo-paratyphoid A," which are sometimes common in the East, were not met with among the cases investigated in this laboratory. *B. paratyphosus* A was found in the urine in one case, in five it was cultivated from the fæces. The diagnosis on the papers which the patients brought with them was in four instances "paratyphoid A," in one "paratyphoid B" (No. 666, a chronic carrier of a mixed infection of paratyphoid A and paratyphoid B), and in one, "dysentery."

The six patients were in two distinct classes:—

(1) *Convalescent carriers*, or patients in whose excreta the bacilli were found towards the end of an attack of paratyphoid fever.

(2) *Chronic Carriers.*

(1) *Convalescent Carriers.*—This group included three patients—Nos. 197, 310, and 656.

No. 197. In this case the bacillus was isolated from the formed stools in the seventh week at the first examination. The results of four subsequent examinations made at intervals of a week were negative.

No. 310. This patient had been "getting up" every day for

nearly a fortnight before reaching England; but, on his arrival, he had a slight attack of malaria, which kept him in bed for a couple of days. *B. paratyphosus* A was isolated from his urine at the first, third, and fifth examinations; the last being in the eleventh week. Thirteen examinations were made subsequently, with negative results, during a period which included the eleventh to the eighteenth week after the commencement of his illness.

No. 656. This patient, the only one who had not been in the East, was admitted five weeks after the commencement of an attack of dysentery in France, during the course of which illness *B. dysenteriæ* (Flexner) had been isolated from his stools. *B. paratyphosus* A was found in his fæces at the first, but not at seven subsequent examinations made during the next four weeks.

(2) *Chronic Carriers.*—This group includes three patients—Nos. 666, 782, 776.

No. 666. This man was a carrier of a mixed infection of paratyphoid A and B. A description of his case will be found under the heading of "Carriers of mixed infections."

No. 782. This patient had an attack of paratyphoid fever in India during October, 1911. In 1912 Captain J. L. Wood, who was working at Naini Tal, found that he was a carrier, and in 1913 he was discharged from the Army. Since then he has been a professional boxer, and at the beginning of the War he was employed as a stoker in some large engineering works. He was in excellent health all the time he was in this hospital, and offered to fight anyone of his own weight for £5 a side. These details are mentioned to show that a chronic paratyphoid carrier may be in excellent health. In the spring of 1916 this man was called up under the Military Service Act; his excreta were examined, he was pronounced free from infection, and taken into the Army.

He told me that, while he was in France, he had "a little fever with a touch of diarrhœa," and reported that he was a carrier. By a strange coincidence he was sent to Captain Wood, who had examined him and found him to be a carrier at Naini Tal in 1912. He was admitted to this hospital on January 22, 1917, and between that date and the 26th of the following month his fæces were examined twenty times, and each time *B. paratyphosus* A was found to be present in large numbers.

No. 776. This case was very similar to the last. He had suffered from paratyphoid fever in India, in 1911, and he was with the last patient, No. 782, at Naini Tal, under Captain Wood. In 1913 he was discharged from the Army. Since then he had been

in good health, and had earned his living as a timber-porter. He was called up in July, 1916, under the Military Service Act. His excreta were examined, he was declared to be free from infection, and was sent to France, where, he says, he was recognized by a quartermaster-sergeant, who had known him in India, and knew that he was a carrier. Eventually, like the last case, he found his way to Captain Wood, and was sent to England. He was admitted to this hospital on January 22, 1917, and transferred elsewhere on February 26. During the interval twenty-five examinations were made of his excreta with positive results on twenty-one occasions.

(*To be continued.*)

TRENCH FEVER.

A Preliminary Clinical Report.

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The cases investigated were mostly of a subacute and chronic nature, and our observations are grouped under the following headings:—

I.—The Acute Disease.

II.—Clinical Observations pointing to a Chronic Stage of the Disease.

III.—Technique of Spleen Puncture.

IV.—Treatment.

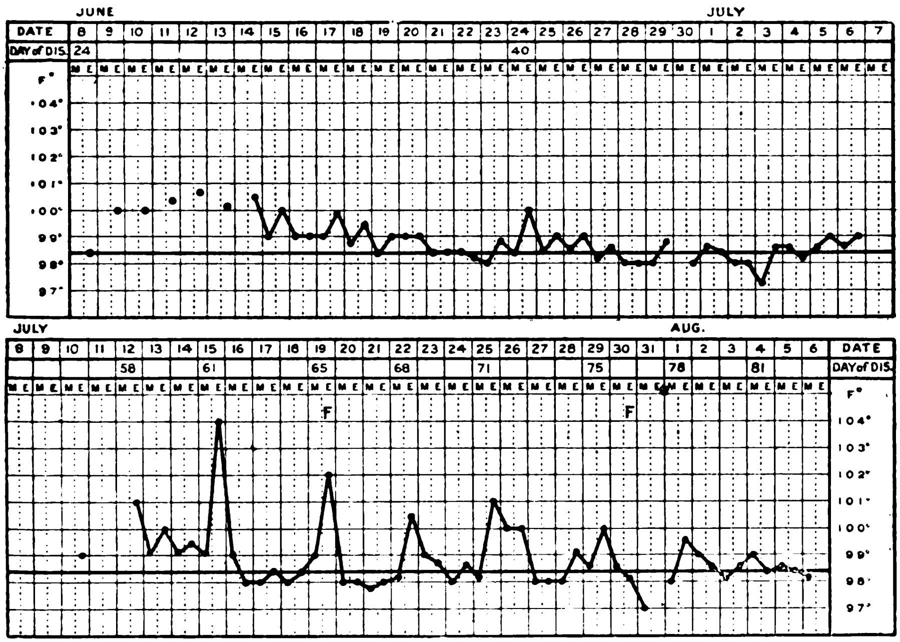
V.—Summary.

I.—The Acute Disease.

The work of McNee, Renshaw and Brunt [1] on Trench Fever made it clear that two types of temperature curve were met with: (1) A frequently irregular but often saddle-back curve showing daily elevations for several days, and (2) an intermittent curve with intervals of apyrexia of varying duration, the whole often covering a period of weeks. These authors showed by inoculation experiments from man to man that the two types represented one disease. We find ourselves in full accord with this view but would go further and suggest that the first type of curve represents the early stage of the disease to which the second is a sequel. This we believe is the invariable order, a view supported by the writings of numerous observers. The report of McNee and his co-workers appears to us to indicate that when inoculation of whole blood or corpuscles was carried out from man to man by means of a syringe the disease was continued in its new host from the point which it had reached in its former host. Thus, temperature tracings were shown in which blood from a patient with the acute form of the disease produced a transition form in a man inoculated with it;

blood from this second man produced, on inoculation into a third patient, a typical intermittent curve. On the other hand, inoculation by means of lice resulted in the appearance of the well-known clinical picture *de novo*, as was shown by the experiment of Davies and Weldon [12]. We think this distinction an important one as pointing to an essential change occurring in the body of the louse. Thus when the disease was first encountered in France in April, 1915, the first type alone was noted, the second type following later. Muir's [2] remarks based upon a twelve months'

CHART 1.



Showing the first type of fever passing into the second type. Also a possible ten-day periodicity rising on the 58th, 68th and 78th days of disease; 61st, 71st and 81st days, and 65th and 75th days. [Treatment by flavine intravenously at points marked F.]

experience with a field ambulance in France recorded the first type only, probably owing to early evacuation of his cases, while Hurst [3] at Salonika saw the intermittent type at first and that only in men from France and Flanders. Coombes [4] describes the whole course of a case seen in Mesopotamia in which the continuous type of fever gave place to the intermittent relapsing. Chart 1 from our wards bears out our contention.

It has been stated by various writers that the disease begins abruptly. This is certainly not the invariable rule. In our series one patient felt increasingly ill for fourteen days before reporting sick and many shorter prodromal periods were noted. Hughes [5] also saw many cases of the early types regimentally, and is positive on the subject of prodromal sensations of malaise. We suggest further that evidence exists indicating that the entire first attack may be so slight as to pass without medical assistance being called for.

The more common prodromal symptoms are a feeling of malaise, "rottenness," headache above the eyes, pains "all over," constipation and an increased tendency to sweating on slight exertion. Sudden collapse usually follows, with *intense* pain in the head and back, and sometimes evidence of gastro-intestinal disturbance; not till later do, in some cases, the characteristic shin pains develop.

Slight enlargement of the spleen is commonly met with in the later stages of the disease and early involvement of that organ seems probable. The spleen area is early tender to palpation, so much so that often this cannot be carried out, and splenic puncture in such a case is only painful when the spleen itself is entered by the needle. It is not uncommon, however, for a patient to be unaware that his spleen is tender before palpation is attempted.

Another question of some importance is that of tachycardia during or immediately following the acute disease. Grieveson [6] speaks of it as occurring in his own case while playing tennis a month after his first attack. This tachycardia did not persist. McNee and his co-workers do not mention it. We feel that, when individual conditions have been allowed for, the immediate effects of the acute disease upon the heart rate differ little from those observed in other acute febrile conditions.

The disease for which acute trench fever seems to be most frequently mistaken is certainly influenza, but in uncomplicated cases the catarrh of the naso-bronchial mucous membranes characteristic of the latter is absent, while the more rapidly contagious epidemic spread of influenza should be a point to guide one.

II.—Clinical Observations pointing to the Existence of a Chronic Form of the Disease.

We were led to the recognition of later chronic stages in the trench fever infection by the fact that a number of trench fever patients of a subacute, passing into a chronic type, were admitted to a section of the Hampstead Heart Hospital in June of this year.

Comparative observation of the two groups of cases (trench fever cases and D.A.H. cases) convinced us that the sufferers from trench fever passed into a state similar to that known as D.A.H. or "the irritable heart of soldiers." The symptoms were exaggerated response of the pulse rate to effort (as controlled by the polygraph), breathlessness on slight exertion or excitement, pain and hyperalgesia over the præcordial or left costal region, giddiness, palpitation and exhaustion. The shins in both groups of cases showed hyperalgesic areas which were elicited by very light pinching of the skin along the outer margins of the tibiæ (i.e., such pinching as would cause no discomfort to a healthy man). In some cases these hyperalgesic areas were acutely painful; patients complained of weak legs which they feared would give way under them. The splenic region in many members of both classes was tender to deep palpation and in a few cases the spleen itself was palpable. It was found that in the subacute and chronic trench fever cases lumbar puncture and the withdrawal of fluid (four to ten cubic centimetres) relieved the shin pains and hyperalgesia almost at once. A similar result was observed in cases of D.A.H. showing these symptoms. Further confirmation of the similarity of the two groups was forthcoming in the temperature charts. In the subacute and chronic trench fever cases sudden rises of temperature with exaggeration of all symptoms were a feature of the course of the disease; these attacks of fever were also typically met with in members of the D.A.H. group.

This comparative investigation revealed to us not only the fact that the trench fever infection is continuous, but that it is protean in its manifestations, and that the so-called "effort syndrome" is certainly one of its sequelæ. It thus became evident that in untreated cases the prognosis was bad because the tendency was for these cases to advance to a chronic condition with symptoms of D.A.H., and also, in certain instances, of neurasthenia. The patients in this chronic stage might indeed present themselves under a variety of guises determined by the most prominent symptoms present, of which D.A.H., "chronic rheumatism," "myalgia," "neurasthenia," and even "malingering" are examples. Are these untreated cases capable of acting as "carriers" of the disease? MacGregor [7] reported the case of an R.A.M.C. orderly who contracted the disease in England while attending cases of trench fever, and Ramsay [8] described "a pyrexia which is prevalent at present among the troops in England." This he suggested exactly met the description of trench fever.

Grieveson reported the spread of the disease in certain affected platoons which "were found to lose within a month sixty per cent of their numbers by trench fever, while other platoons lost practically none. . . . All but a very few cases could be traced to a small group of bedfellows, or rather co-sleepers." He concludes: "Add to these" (trench fever cases) "the D.A.H.'s derived from trench fever cases, but only admitted as trench fever, and add too the undiagnosed cases (and such form a large number I believe), and you have a morbidity-rate which can only be equalled by such plagues as typhus or as typhoid formerly, or as malaria." The danger from untreated "carriers," no matter under what diagnosis they may present themselves, is thus evidently a very serious one.

In order to show the chronic character of the disease a case of our own (Case 7) may be described.

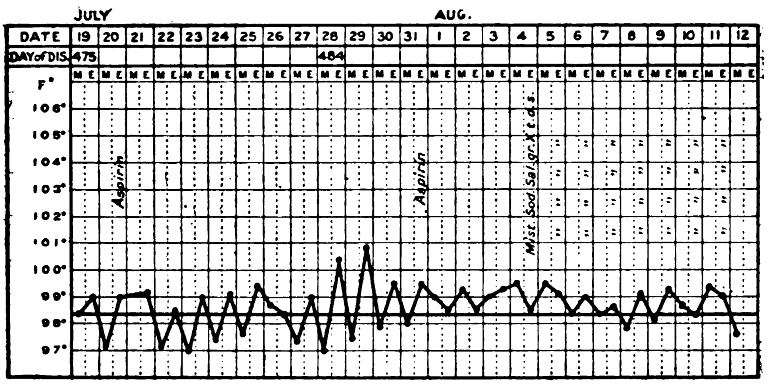
Patient, after suffering in youth from pneumonia, dyspepsia, and slight hæmorrhoids, joined the Army on February 5, 1915, as an A1 man and was passed to the Royal Fusiliers. He was fit and went through his training without difficulty. Training lasted from February, 1915, to November, 1915. In November he went to France, where he remained well and at full duty till the spring of 1916, when he reported sick several times with pains in the back, head and legs. This was diagnosed as "influenza." After he returned to duty he noticed much aching in his knee-joints and some headaches. He was admitted to hospital in France three times, each time with fever. In September, 1916, he was admitted to hospital—his third admission—with pains in back and legs, including thighs, and headache. The leg pains were worse in the evening. Temperature was 103° F. He was confined to bed for four weeks. There was no swelling of the joints, but pain was present in the right side of the chest. A diagnosis of rheumatic fever was made, and the patient was invalided to England, where he spent two weeks in bed and ten more in hospital. On getting up he noticed that he was breathless.

His headaches continued until his return to France in March, 1917. Four days after he landed in France he reported sick with fever and was excused duty for four days. He then finished his training. In the middle of June he again reported sick with fever and pains in the head, back, and legs, becoming worse in the evening. This time he was excused duty for ten days.

On June 30, 1917, he was sent to a Field Ambulance with symptoms as above. From there he passed to a Base Hospital,

where he remained fourteen days. There was no pain in the chest or left hypochondrium. He was diagnosed as trench fever and invalided to England. He was admitted to hospital at Hampstead on July 14, 1917. This was approximately the four hundred and seventieth day of the disease. From this date the temperature continued to rise above 99° F. every night, and on July 28 and 29 it rose well above 100° F. (Chart 2). As a rule it was subnormal in the morning. On August 13, however, the evening temperature rose only to 99° F., and the following day it was normal. It continued more or less normal till August 21, when it shot up suddenly at 6 p.m. to 100·8° F. At 10 p.m. it had returned to normal The following afternoon at 2 p.m. it was 99·4° F. After that it settled again and did not rise above 99° F. till 6 p.m. on the 29th. On September 5, however, it rose at 6 p.m. to 99·2° F., and on the 7th to 99·6° F., and on the 9th to 99·8° F. A rise to 100° F. was noted at 6 p.m. on the 19th.

CHART 2.



Case 7 from 475th day of illness.

On examination the patient was found to be a man of good physique, but looking ill. His colour was fairly fresh. The skin was marked by the presence of a number of papules distributed over those areas most likely to be rubbed by the patient's clothes, the shoulders and buttocks. A thin yellow-white fur covered the tongue, many of the teeth were carious. The patient complained of constant aches in legs and shins, worse at night. He described the feeling in his legs by the statement that it "seemed as if my legs would perhaps drop under me." The deep and superficial reflexes were exaggerated. Hands and feet were sweating, and the

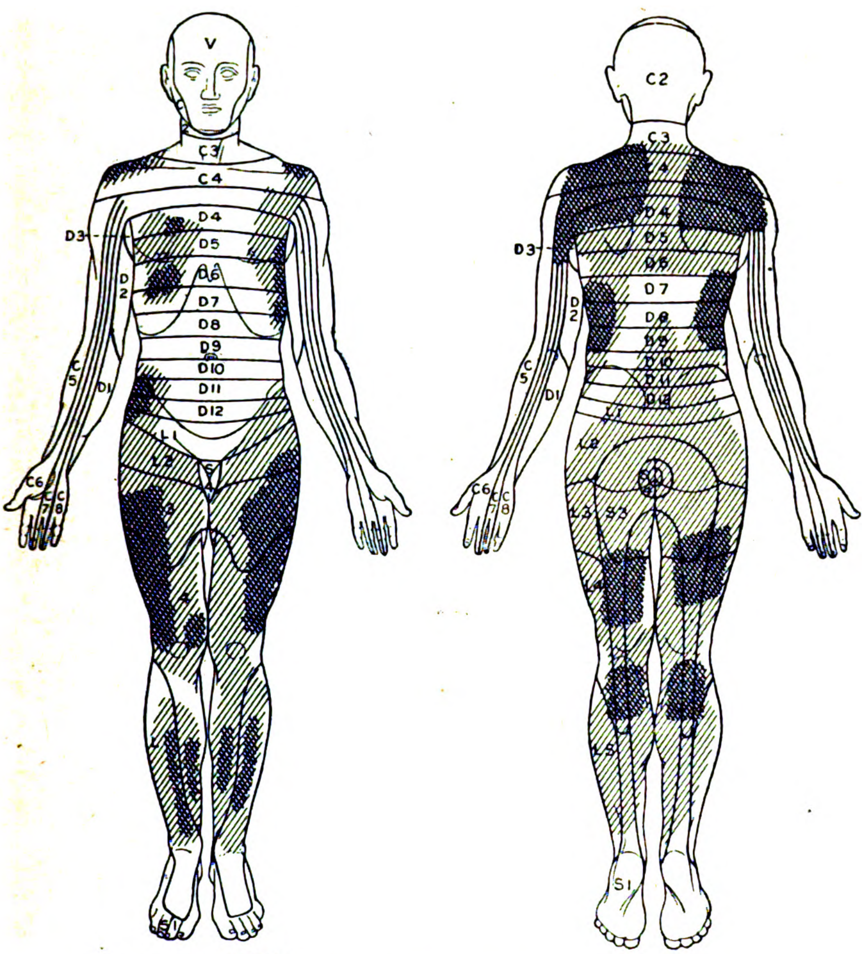
hands were tremulous. A vivid red tache was elicited by stroking the skin of the back and chest. The lungs were clear. The area of splenic dullness was markedly enlarged to percussion, but on account of the tenderness of the left hypochondrium, palpation could not be carried out. The patient complained of the symptoms which Lewis [9] has named the "effort syndrome"—breathlessness on exertion or excitement, giddiness, palpitation, and exhaustion. The pulse became markedly quicker on exercise. Præcordial pain also occurred on exercise. The heart was not enlarged, and there were no abnormal sounds. Pulse 96, regular. The blood-pressure, which was 120 systolic, showed an abnormally high diastolic, 100. The "phases" were present, but were abnormally short in duration. His radials and the dorsal arteries of his feet were all of moderate calibre and showed a marked degree of thickening, though no nodulation or hardening. Hæmoglobin estimation carried out on September 4 (Haldane's method) gave ninety per cent hæmoglobin, a further examination on September 13 gave eighty per cent. The patient complained of considerable hyperalgesia and deep muscular tenderness, and the areas were charted, first on September 7, when the temperature was 99·6° F., and the patient evidently feeling unwell, and again on September 18, when the temperature was 99° F., and the patient was feeling better (Charts 3 and 4).

It will be seen from this history, which is representative of the group of cases under discussion, that a prolonged period of chronic illness, with apyrexial and pyrexial periods, each of the latter being marked by the same symptoms, followed the initial attack in the spring of 1916. The onset of the initial attack was a gradual one, accompanied by headache of growing intensity and pains in the legs. Once established, the disease in each succeeding pyrexial period manifested increasing severity up to September, 1916 (the third admission to hospital), which was described by the patient as his worst attack, and which kept him in bed for six weeks and in hospital for ten weeks longer. Thereafter a more chronic phase began, marked at intervals by short periods of pyrexia with pain and sweating and by the symptoms of the effort syndrome. The patient first came into contact with lice in the trenches in December, 1915, but managed to keep "pretty free" till April, 1916, after which he was often "swarming." He last felt quite fit in March, 1916.

The hyperalgesia and deep muscle tenderness were found to be a constant symptom of the chronic cases of trench fever during pyrexial periods. As a rule, about thirty-six to forty-eight hours

before a rise of temperature the patient would complain of feeling "sore all over." Examination of the skin by light pinching would confirm this statement. During the ensuing period of apyrexia

CHART 3.



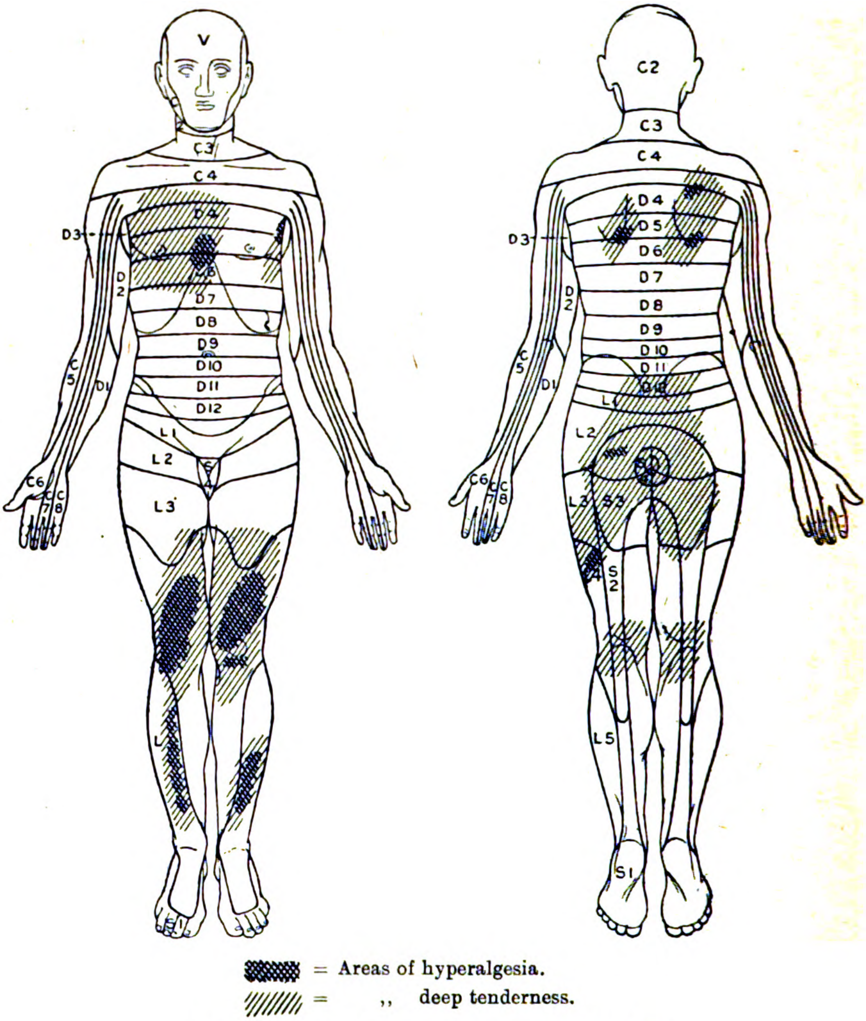
= Areas of hyperalgesia.
= ,, ,, deep tenderness.

No. 7.—Patient feeling ill. Temperature 99·6° F.
[This chart as figured is approximate only.]

examination would show that the large areas of hyperalgesia had shrunk to quite small dimensions or might have disappeared altogether. Meakins and Gunson [10] observed a somewhat

similar phenomenon in certain cases of D.A.H. investigated by them. The hyperalgesia is frequently bilateral in distribution; so far as the legs and shins are concerned it can be relieved at once,

CHART 4.



No. 7.—Patient feeling well. Temperature 99° F.
[This chart as figured is approximate only.]

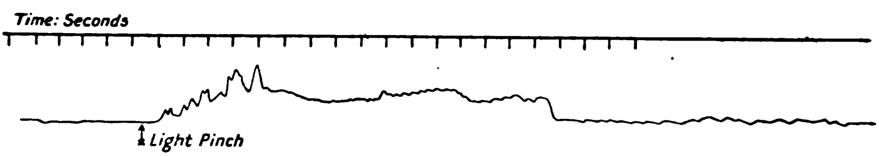
as we have proved to our satisfaction, by lumbar puncture and the withdrawal of from four to ten cubic centimetres of fluid. It is accompanied by increased response to stimuli throughout the whole

body, by marked tremor, by a tendency to muscular twitchings and by breathlessness, palpitation and sweating on light exertion or slight excitement. We take the view that, along with concomitant symptoms, it must be looked upon as an expression and sign of an increased irritability of the whole nervous system. We therefore believe that the toxin of trench fever exercises a powerful action upon the nervous system.

If this hypothesis be accepted, the mechanism of production in these cases of such sequelæ as D.A.H., neurasthenia, nerve shock, etc., becomes comprehensible. The whole body is reacting in an exaggerated manner. Every stimulus, whether of emotion, of effort, or of intercurrent infection, produces a response beyond the normal. Tissue metabolism and waste are exaggerated, the factor of over-exertion and "strain" complicates even the smallest efforts and sensations of life; life becomes a burden.

(In one of our cases a light pinch of the skin above the knee produced a contraction of the quadratus femoris muscle lasting sixteen seconds. Chart 5.)

Chart 5.—Gross Muscular Contraction on Light Stimulus.



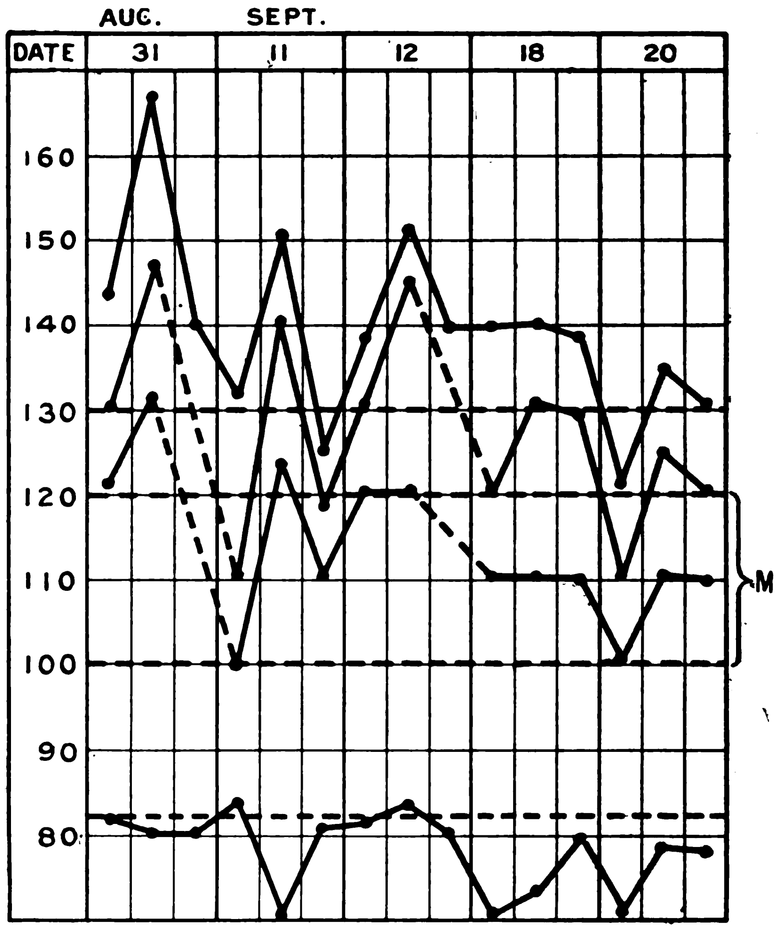
A bag-tambour was fixed round patient's thigh. This was connected with the polygraph. A light pinch was given to skin above the patella at ↑. The quadratus femoris muscle at once went into strong contraction of an entirely involuntary character. The experiment was repeated frequently with the same results. [Copy of polygraph tracing.] Time of muscular contraction 16 seconds.

Enlargement of the heart has not been observed by us so far, but the area of cardiac dullness, as revealed by percussion, has been apparently increased slightly in a number of cases.

There has been met with in the majority of instances a thickened condition of the arteries. We do not however suggest that this has been caused by trench fever. As regards blood pressure, we are aware that in this country the study of "phases" heard by the auscultatory method is largely discarded. Yet while our group showed generally a normal systolic pressure and what may be taken as a normal diastolic pressure, the phases in many cases have been conspicuously absent on the patients coming under observation. They have tended to return as the condition improved

Whatever may be the value of blood-pressure findings, we are convinced of the accuracy of the following observations: that within a certain well-defined range the systolic and diastolic pressures are

CHART 6.—CHART SHOWING BLOOD-PRESSURE RECORD OF A CASE (2) FROM THE SECOND TO THE END OF THE FIFTH WEEK OF TREATMENT.



The broken horizontal lines indicate the systolic and diastolic pressure and the duration of the murmur phase marked M as found in healthy soldiers of this age. Note the diminishing range of the systolic rise after effort; the absence of the murmur phase in the first and third observations; its presence and approximation to the observed standard in the last two readings. Each observation is made sitting just before, one minute after, and two minutes after effort.

constant factors in health. We have also observed that in over ninety per cent of healthy people the murmur phase is distinctly audible, and that it bears the relation to the other phases as indi-

cated in the chart (Chart 6). In conditions of disease on the other hand, though the systolic and diastolic and pulse pressures may all fall within the accepted normal limits, the murmur phase is conspicuously absent.

The patients are generally anæmic. The most marked anæmia observed showed a hæmoglobin estimation of 70 per cent; the average hæmoglobin estimation was 81·8 per cent, the highest 100 per cent.

Almost without exception the patients stated that they were losing weight or that they had already lost weight; the following record of nine cases selected at random illustrates the findings generally:—

	Usual weight (clothed) as stated by patient	Normal weight (for height and age)	Actual weight (on admission)
	169 lb.	166 lb.	152½ lb.
	178 ,,	172 ,,	137 ,,
	174 ,,	168 ,,	142 ,,
	182 ,,	172 ,,	147 ,,
	160 ,,	142 ,,	133 ,,
	143 ,,	142 ,,	121 ,,
	148½ ,,	141 ,,	148½ ,,
	141 ,,	139 ,,	132 ,,
	126 ,,	113 ,,	113 ,,
	1,421½ lb.	1,355 lb.	1,226 lb.
Average	157·8 lb.	150·5 lb.	136·2 lb.

A feature of the majority of the cases was a mild congestion of the margins of the eyelids.

The pains in back and legs formed so conspicuous a symptom of the cases while febrile attacks were approaching or actually in progress that it was not surprising to find the cases diagnosed as "myalgia" and "rheumatism." Moreover, the weather exercised an undoubted influence on these pains, so that the men themselves knew by the increase of discomfort when it was going to rain, and, by the decrease, when fine weather might be expected. This further close resemblance to rheumatic pains is worthy of note and careful consideration.

In the cases we have recorded the duration of illness varied from eighteen months to three months. The average was about six months. In one instance no fewer than thirteen waves of fever were met with in five and a half months, in another ten in four and a half months, in yet another seven in four months; on the other hand several of the cases had had but one fever wave though many of them showed slight evening rises of temperature. The intervals

between the waves of fever varied. In one case having ten waves of fever a six months interval elapsed between one attack and another. When several attacks occurred, the intervals between the earlier ones were generally much shorter than those between the later. The lengths of the waves of fever also varied widely—from seventeen days to two days. In the intervals the temperature charts commonly showed an evening rise to normal or 99° F. and a morning fall below normal. A notable feature of some of these chronic cases was a daily swing of temperature of from 2° to 3° without any true pyrexia. The very slow and long-continued nature of the infection was especially well shown in the cases of two officers examined by us.

The "field card" diagnoses of our cases have varied and include trench fever, myalgia, P.U.O., D.A.H. and rheumatic fever.

III.—Note on the Technique of Spleen Puncture.

Technique of spleen puncture, more especially when the spleen does not extend below the costal margin. Spleen puncture has been undertaken in order to examine the blood for possible parasites.

The operation is only performed after a consultation in which we all take part and deal with the pros and cons in view of the accidents which have attended its employment in cases of kala-azar.

In order to avoid the possible danger of puncturing the spleen in case of a bleeder, a rough measurement of the coagulation time of the blood should be done in capillary tubes. A coagulation time under five minutes is to be taken as a contra-indication for the operation.

Technique, where the size of the spleen is normal or only slightly enlarged:—

An imaginary line is drawn outwards to the left from the interspace between the twelfth dorsal and first lumbar spines. The point where this crosses the eleventh rib is noted, and provided percussion and other clinical evidence corresponds, puncture can be performed at this point.

The site of puncture lies in the area between the posterior axillary and mid-scapular lines. The puncture is made forwards and inwards and the patient educated for a time, before the actual puncture, to respire as quietly as possible, or as an alternative, if the patient is at all nervous, he is instructed to inspire deeply several times just before the puncture.

The puncture may also be made in the same vertical line in the upper part of the last intercostal space in cases where the organ is somewhat enlarged. The puncture to be made forward and slightly upwards and inwards.

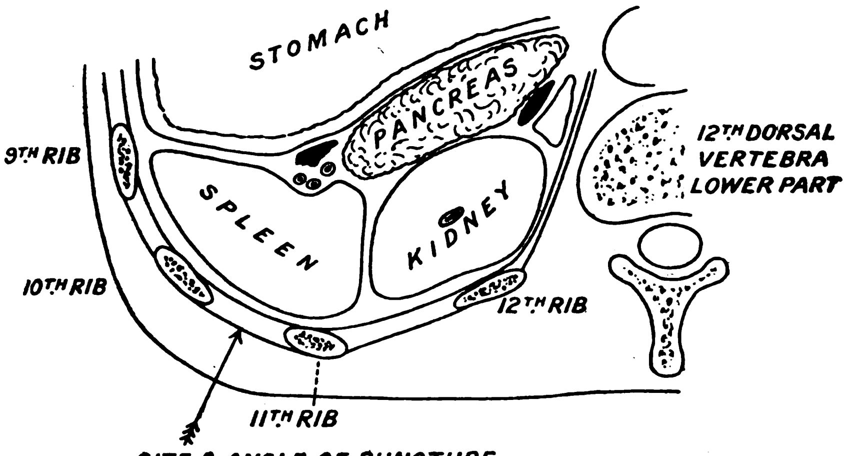


FIG. 1.

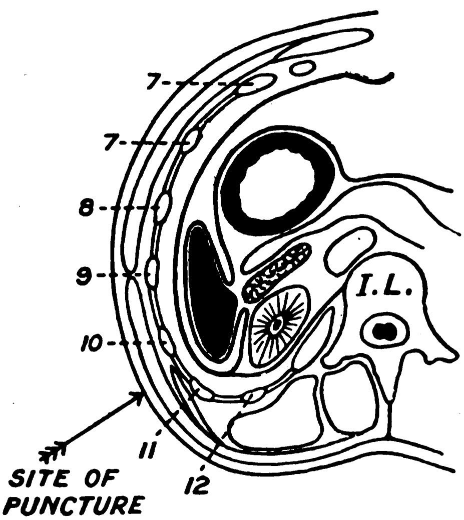


FIG. 2.—**Structures pierced in spleen puncture ; horizontal puncture as seen on section of the body at the level of the body of 1st lumbar vertebra.**

The needle employed is invariably the finest platino-iridium needle obtainable and at least 1½ inch long. The attached syringe should be one in which the suction is powerful.

We consider that such spleen puncture should not be performed unless it has been carried out previously on the cadaver.

Care must be taken not to lacerate the organ and the needle should not be moved from side to side whilst in the organ in order to obtain the pulp.

In the majority of cases a little blood containing spleen cells is obtained; occasionally the fluid obtained is a cloudy serum, which on examination usually contains spleen elements, and a few blood corpuscles.

IV.—Treatment.

Based on experience of less than two months, these remarks are offered as a bare statement of the facts we have noted and of our tentative interpretation of the same.

Of first importance in considering the promise of treatment is the fundamental physical condition of the man. Those with a bad history of exanthemata in youth and evident susceptibility to other infectious diseases in later life, or with long-standing digestive disturbances or other disorders of nutrition respond but slowly to treatment. Equally unsatisfactory subjects are those showing evidence of early degenerative states, as, for example, arterial thickening beginning, renal insufficiency, or abnormal blood-pressure relations (Cases 1, 2, 3, 5, and 7).

No less important is the duration of the disease. In our practice we date this from the time preceding the first acute attack, when the sensations which increased, and finally culminated in, an active outburst were first noticed. Other things being equal, we are convinced that the difficulty of restoring a man to health increases directly with the duration of the disease. We have noted that in several cases (1, 5, 6, 7 and 11) where the infection was associated with pre-existing chronic debility, it showed a tendency to increase rather than to "die out." A progressive infection of eighteen months was the limit of our personal experience.

Whatever method of treatment be adopted, we have become convinced that until the infection is overcome all exercise is harmful; and further, that during the second stage of treatment, that of upbuilding during convalescence, exercise, if permitted, should be moderate, pleasurable and not exhausting. Gymnastic exercises under the eye of a drill instructor will not neutralize the damage being done to the tissues by a persistent intoxication. As a clinical guide to the effect of treatment, we estimate, quite independently of the blood picture, the degree and duration of pain, and the extent

of hyperalgesia of skin, tendon and muscle. These are controlled objectively by records of weight, hæmoglobin estimations, presence or absence of the effort syndrome (D.A.H.), polygraph tracings of any irregularities which may be met with, and blood-pressure relations.

Of the whole series treated, but one case, No. 7, has shown no improvement, his being the most chronic infection and his condition being complicated by an extreme degree of oral sepsis.

The table given below is a complete list of all cases which have been under treatment by galyl or acriflavine for three weeks or more. Of the acriflavine series, six cases (1, 4, 8, 9, 10 and 11) show enough improvement to justify a prognosis of recovery, and one case (13) of the galyl series is distinctly better.

The galyl series shows that this drug does not compare favourably with acriflavine. Intravenous doses may prove more satisfactory, but we have not tried them. It would serve no purpose to discuss the intervals of doses or the quantities given. The one single dose of acriflavine found to be effective was 0·230 gramme (Case 4). The smallest effective repeated dose was 0·100 gramme given in daily doses of 0·025 gramme. The largest repeated dose, given at irregular intervals, was 1·975 grammes (Case 1).

We find that 200 cubic centimetres of a 1/1,000 solution of acriflavine in normal saline, is a quite satisfactory maximum single dose. The drug we have used is acriflavine, supplied to us by Professor Browning.

Large dosage or higher concentration is apt to produce a reaction an hour after with slight rise of temperature, and with signs so like a trench fever wave that we believe that it is entirely due to the sudden liberation of toxin in large amount (Cases 1, 4, 8 and 9). We should add that as much as 500 cubic centimetres of a 1/1,000 solution have been given intravenously in the hospital, in a single dose, in a case of suspected streptococcal infection, without any reaction being noted.

Just before and within an hour after large doses, careful white counts have been made, and it was found that the number and condition of the white cells were in no way affected (Cases 1, 2, 8, 9).

We have noted that after a large dose a faint trace of albumin became evident in the urine and persisted for three days; microscopic examinations proved negative (Case 2). A similar finding was noted after the twelfth dose in Case 11.

Fourteen days after a dose of 200 cubic centimetres (1/1,000)

the urine was still distinctly fluorescent. The routine we are at present following is the daily small dose (0·025 gramme) as in Case 11. This is no hardship to the patient, if a fine gauge, oblique-pointed platino-iridium needle is used. We have now given 284 doses of acriflavine intravenously, in doses ranging from 0·001 to 0·25 gramme and have observed no more serious untoward effects than those noted above.

Galyl has been used only intramuscularly, this method being selected in the hope that the slowness of absorption would be an advantage. The doses ranged from 0·1 to 0·2 gramme and the intervals about one week.

All our patients had had salicylate of soda or aspirin in varying doses—the largest amount taken was by Case 1 who had had fifteen grains of aspirin t.d.s. "for weeks." Though this group of substances always gives temporary relief of pain, the persistence of the symptoms and the recurrent attacks of fever point to its failure (in such doses at any rate) as a specific.

Lumbar Puncture.—In certain cases, and while the pain in the legs was extreme and bilateral in its distribution, it was found that the withdrawal of ten cubic centimetres or even less of fluid gave immediate relief of both pain and hyperalgesia. It is noteworthy, however, that in subsequent rises of temperature there was some return of both.

Local Measures.—Twenty drops of a solution (menthol ten grains, ol. gault. two drachms) applied to the painful areas, covered with protective tissue, and over that a layer of cotton wool and a bandage, give very prompt relief.

Hot soda soaks and radiant heat also mitigate the pain, but give no permanent relief.

Tonic Treatment.—Attention to the general condition of the man—in our series we noted constipation, indigestion, oral sepsis, weak feet, and defective vision.

We have noted in several cases disturbances evidently attributable to the endocrine organs.

Two very chronic cases of the series which showed the *tache surrénal* of the French writers were treated with $\frac{1}{10}$ grain of powdered thyroid gland t.i.d., p.c., with the result that relief of otherwise stubborn discomfort was noted on the fourth day. The tache is demonstrated by sharply, though rather lightly, stroking the skin of the forearm. No hyperæmic line results, but rather a thin raised line which is quite often the centre of a broad white band of blanched tissue about a quarter of an inch in width. We are now making a test of the value of a diet rich in vitamines.

As a general tonic during convalescence the following is satisfactory.

℞	Ferri et quin. citratis	gr. v.
	Tinct. nucis vom.	♏iv.
	Liq. arsenicalis	♏iv.
	Calcii hypophosphytis	gr. v.
	Menthol	gr. ¼.
	Spt. chloroformi	♏x.
	Aquam .. .. q.s. ad	℥i

ʒi t.d.s.

Preventive treatment, as understood in this section, resolves itself into a careful study of the prodromata and the search after means of eradicating the infection before it has gained the upper hand, which is not achieved in a large proportion of cases by present methods, with the result that much wastage of men occurs and an ever-increasing army of possible carriers is formed in our midst.

We would appeal to other workers to test the value of the various anti-protozoal compounds for this purpose. We have so far no data as to the value of acriflavine by mouth, but one of us, in order to ascertain its effect on the stomach, has taken ten cubic centimetres of the solution four-hourly for the past six days without being aware of any discomfort. This is merely mentioned for what it may be worth to one so situated that intravenous treatment is not at the moment possible.

TABLE SHOWING COMPARATIVE RESULTS OF TREATMENT WITH ACRIFLAVINE AND GALYL.

	No.	Day of disease after onset of attack on which treatment begun	Total quantity given (grm.)	Number of injections	Period in days over which treatment was spread	Progress
Acriflavine	11	177	0·318	14	16	Marked improvement.
	1	124	1·195	12	46	,, ,,
	4	98	0·230	1	1	To duty.
	2	92	0·915	7	54	,,
	8	76	0·560	3	16	,,
	9	70	0·740	5	51	,,
	14	58	0·265	4	18	Slight improvement, treatment interrupted, July.
Galyl	7	502	0·80	5	29	*Nil.*
	5	137	0·60	4	27	Slight improvement.
	12	84	0·80	4	24	,, ,,
	15	67	0·18	1	1	Slight improvement, treatment interrupted.*
	13	57	0·38	3	10	Marked improvement.
	3	38	0·80	5	29	*Nil.**

* Has since shown very decided improvement after galyl intravenously.

Too much emphasis cannot be laid on the need to find at the earliest possible moment a curative treatment. The disastrous effect of the toxin on the nervous system of so large a number of our men and officers each month is evident to us all at the base.

When as close an observer as Captain Fairley Marris assures us that the first attack is usually followed by complete recovery, he makes it clear that the chronic disturbances which maim are events associated with the later development of the infection: and we cannot be too insistent on the point that our treatment should be such that the first attack is the last. Such an achievement would mean the saving at the present time of a force greater than the famous "First Seven Divisions." Work on the methods of transmission of this disease is obviously of urgent importance.

Summary.

The extreme importance of trench fever as a drain upon the Army at present must be our justification for publishing a report on such immature work, and we therefore make no excuses.

Our report has attempted to show that:—

(1) The well-known types of trench fever, with later a stage of slight pyrexia, headaches, anæmia, splenic enlargement and increased irritability of the nervous system are one disease in succeeding stages, the generally unfit man being most susceptible to the development of the chronic type.

(2) This nervous irritability is the cause of a certain proportion of the D.A.H. cases now arising in France and other theatres of war.

(3) Trench fever in its various stages is often misnamed P.U.O., influenza, rheumatism and myalgia.

(4) Present methods of treatment are not truly curative but are resulting in the formation of many possible carrier cases.

From which it may be seen that no steps are too arduous or expensive which will help to arrive at means of prevention and cure.

In conclusion we offer our sincere thanks to Lieutenant-Colonel A. Webb, C.M.G., without whose help and advice our work could not have been done, also to Lieutenant J. H. Churchill, R.A.M.C.(T.) who has assisted us with hæmoglobin estimations and blood counts.

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[7] "A Case of Trench Fever contracted in England." By R. D. MacGregor, B.A., M.B.Oxon., Captain, I.M.S., retired, *Brit. Med. Journ.*, February 17, 1917.

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Clinical and other Notes.

LOCALIZATION OF BULLETS AND SHRAPNEL BALLS BY ONE RADIOGRAPH ON ONE PLATE.

By Captain A. HOWARD PIRIE.
Canadian Army Medical Corps.

Many bullets and shrapnel balls are found quite undeformed in the wounded, and it is then possible to make a rapid localization of them from a single radiograph on a single plate. It is assumed that such bullets and shrapnel balls are of constant shape and size. This we assume from practical experience during the last fourteen months. To carry out this method it is necessary to have a key radiograph (fig. 1). This was made by making radiographs of a German bullet and shrapnel ball at the following distances from the plate:—

0, ½, 1, 1½, 2, 2½, 3, 3½, 4, 4½, 5, 5½, and 6 inches.

As fig. 1 is reproduced natural size, it will act as a key radiograph to those who wish to use the method.

Bullets.—The diameter of a bullet casts a shadow which is proportional to its distance from the plate, no matter at what angle the bullet is lying. The length of the bullet is no guide as to its depth, but under all circumstances, its breadth can be relied upon. Consider first a bullet which lies parallel to the plate. It has a uniformly cylindrical part which at one end tapers to a point, and at the other end is blunt and indented. It is the uniformly cylindrical part which acts as our guide, and by measuring its greatest diameter, then comparing this measurement with the corresponding key figure, we get the distance from the plate of that part of the bullet measured. The bullet should theoretically be in the perpendicular ray, but for practical purposes, if it is within six inches, the error is small and may be neglected. With a fine pair of dividers the greatest diameter of the shadow is measured, and the dividers then transferred to the key plate, and there placed on the bullet shadow, which they fit exactly. The distance of the bullet under consideration from the plate is then the same as the known distance of the bullet in the key plate. To find the other two dimensions in space, the radiograph must be made with cross wires and the perpendicular ray falling on the cross. Join by a line the centre of the bullet to the crossing of the cross wires, and calculate as follows (fig. 2):—

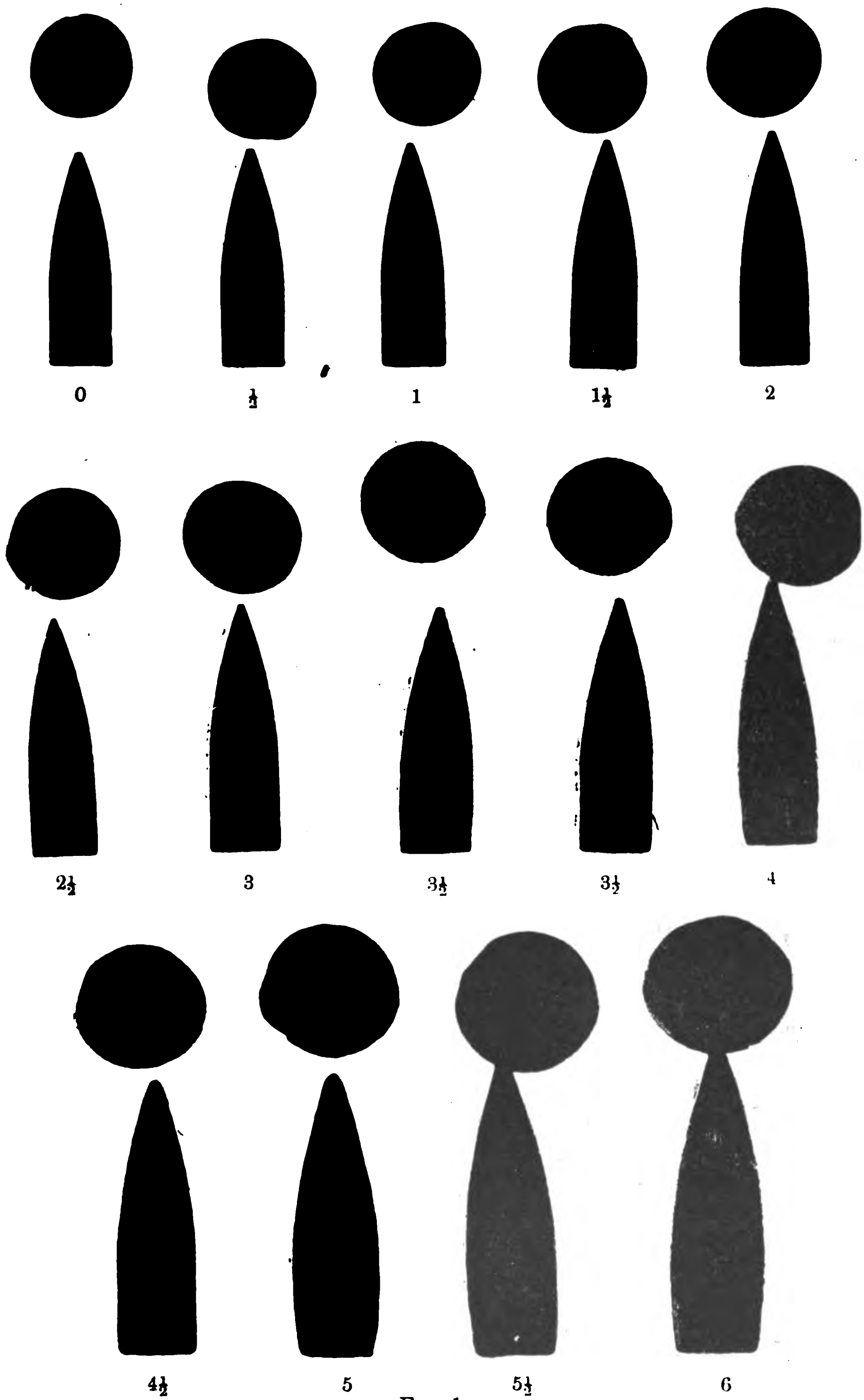

Fig. 1.

The point D can now be marked on the radiograph along the line joining the centre of the bullet to the crossing of the cross wires. By measuring the distance of D from the cross wires, the two other dimensions in space are obtained.

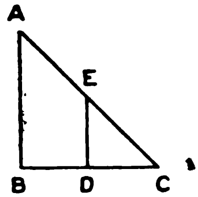

FIG. 2.

A B is the perpendicular ray.
B is the intersection of the cross wires.
E is the centre of the bullet.
C is its shadow.
D E is the depth as found above.

$$BD = \frac{BC\,(AB - ED)}{AB}$$

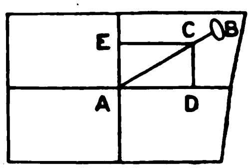

FIG. 3.

Join AB and measure it, say = 5 in.

Suppose the depth has been found from the key plate equal to 5 in., and that the perpendicular ray was 20 in., then the actual position of the bullet from the above formula—

$$= \frac{5\,(20 - 5)}{20} = 3\tfrac{3}{4} \text{ in.}$$

Measure from A $3\tfrac{3}{4}$ in. to the point C. Draw CE and CD perpendicular to the cross wires. EC and CD are the other two dimensions required, and can be measured with a foot rule.

As an example, take a plate showing the cross wires and bullet, as in fig. 3.

Shrapnel Balls.—The same method can be used for shrapnel balls provided that they are not deformed. Experience has proved that when they are slightly deformed a practical result is obtainable. If one wished to be theoretically correct as to the depth of the shrapnel ball, one would have to use a formula which is much too long for everyday use. It is as follows :—

In fig. 4 the cross wires and the oval shadow of the round ball are shown. Join A to the long diameter of the eclipse.

The Degree of Blurring of the Shadow.—On occasions during a rush time we have made more than eighty radiographs in a day. At such a time when only one radiograph had been made of a patient, we have been able to form an estimate of the depth of a piece of shrapnel or bomb by considering the degree of blurring of its shadow. Fig. 1 shows how the degree of blurring increases as the bullet is placed farther from the plate. At the same time one can estimate how still the patient has kept by the blurring or sharpness of one of his bones near the shrapnel. When the foreign body is in the chest or abdomen no reliance can be placed on the degree of blurring. One would not advocate serious localization by such a method, but during rush times it has proved of practical value.

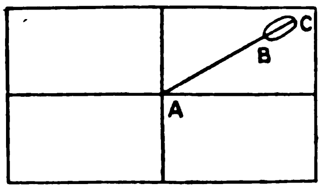

FIG. 4.

Let r = radius of shrapnel ball (a known quantity).
,, x = distance of centre of ball from plate.
Call distance AC = A.
Call length of perpendicular ray used = C.
Call distance AB = D.

$$\text{Then } x = C - \frac{C\,R}{A - D}\left(\frac{\sqrt{C^2 + O^2}}{C} + \frac{\sqrt{C^2 + A^2}}{C}\right)$$

An electro-magnet installed in the operating room, supplied by thirty amperes 110 v AC., has saved the necessity of many localizations by X-rays. The tremor of a bullet two to three inches below the surface can be felt so that no X-ray localization is required. By means of a modified Hughes balance, I have also been able to locate a bullet two inches from the surface and even recognize a mass of metal at five inches. The Hughes balance responds to lead and brass when they are superficial, but beyond one inch I have not found it of practical value for these metals.

Conclusions.—(1) Bullets and shrapnel balls of the present war can be localized by a single radiograph. (2) The degree of blurring of the image is useful for estimating the depth of a foreign body. (3) The electro-vibrator of Bergonié (electro-magnet) saves many localizations by X-rays. (4) The Hughes balance in a modified form is useful for locating foreign bodies.

THE FIELD KITCHEN AT A CASUALTY CLEARING STATION.

By Lieutenant and Quartermaster VAL. A. BELL.
Royal Army Medical Corps.

The presence of "all sorts and conditions of men" in our new armies has led to the development of an enormous number of original ideas in every spot where a British unit is encamped. No sooner is an idea thought of, than there are a dozen willing workers at hand to give it being. Naturally, the R.A.M.C. units are well to the fore and at general and stationary hospitals, casualty clearing stations and field ambulances, splendid ideas for making the work of the unit more effective may be seen. No two units may be placed under similar conditions, yet someone is always ready to suggest ways of overcoming difficulties that may arise and the result is the production of scores of most useful and novel inventions dealing with such things as grease pits, incinerators, baths, latrines, field kitchens, lighting apparatus and operating tables.

The justifiable pride of those who have suggested and created these novelties is as generally appreciated as the initiative which has called them into being and it is well for future reference to place some of them on record.

The casualty clearing station is a great place for the development of ideas. Fitted out as a mobile unit, its function has, "owing to the exigencies of the campaign," been considerably altered. The pitching of its marquees in a certain spot for a short time, to clear the wounded, has not happened very often and it has often found itself practically *stationary*, remaining on the same site for more or less long periods of time. Frequently, buildings such as factories, schools and chateaux have been taken over and made the centre of the station and these buildings have had to be adapted to the work of a hospital. The C.O's and units have been fertile in ideas and have been prepared to meet any contingency that has arisen,

Certain casualty clearing stations, however, have had to be practically all under canvas and the one from which I am writing is of that class. Its present site is a hay-field which was taken over, during the snows at the beginning of March, from the French. Four large unfinished huts occupied part of the ground. Two more have been erected and with all the marquees and tents pitched, the station has now accommodation for 750 patients.

The cooking arrangements under the circumstances were a very serious question. At first the "decksies" and field ovens were placed over the ordinary trench fires, but the expenditure of fuel, the smoke nuisance, the wet weather and the knowledge that the stay would be a protracted one, soon led to something more useful and more comfortable being substituted.

Fortunately Pte. G. Davies had been transferred to the unit as cook, and under his supervision the cook-house was built according to the rough plan, fig. 1. He was ably assisted by Ptes. G. White and W. Crombie.

The chief points of interest are the arrangements for heating the camp kettles and the portable ovens.

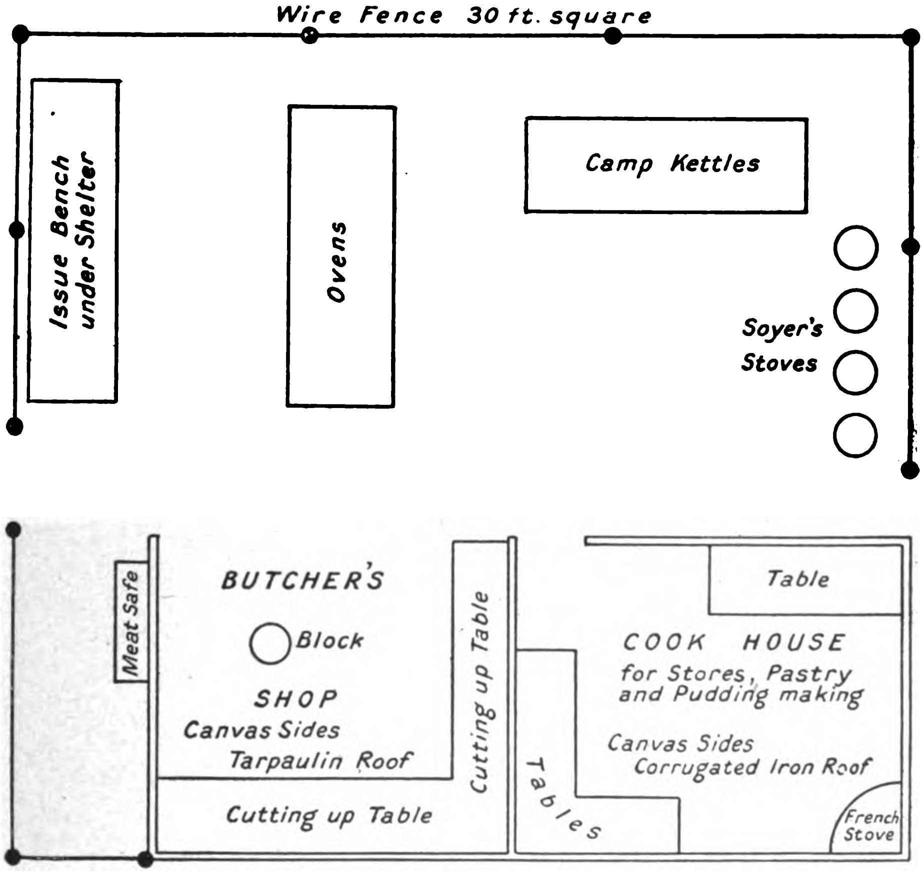

FIG. 1.—Plan of hospital kitchen.

The Arrangement for heating Camp Kettles.—The rough drawing (fig. 2) will convey the idea fairly easily. Two brickwork channels were erected just wide enough to allow the iron rings, where the handle of the "decksie" is fastened, to rest on the bricks (fig. 3). The length of the channels was designed to accommodate six utensils. After four courses

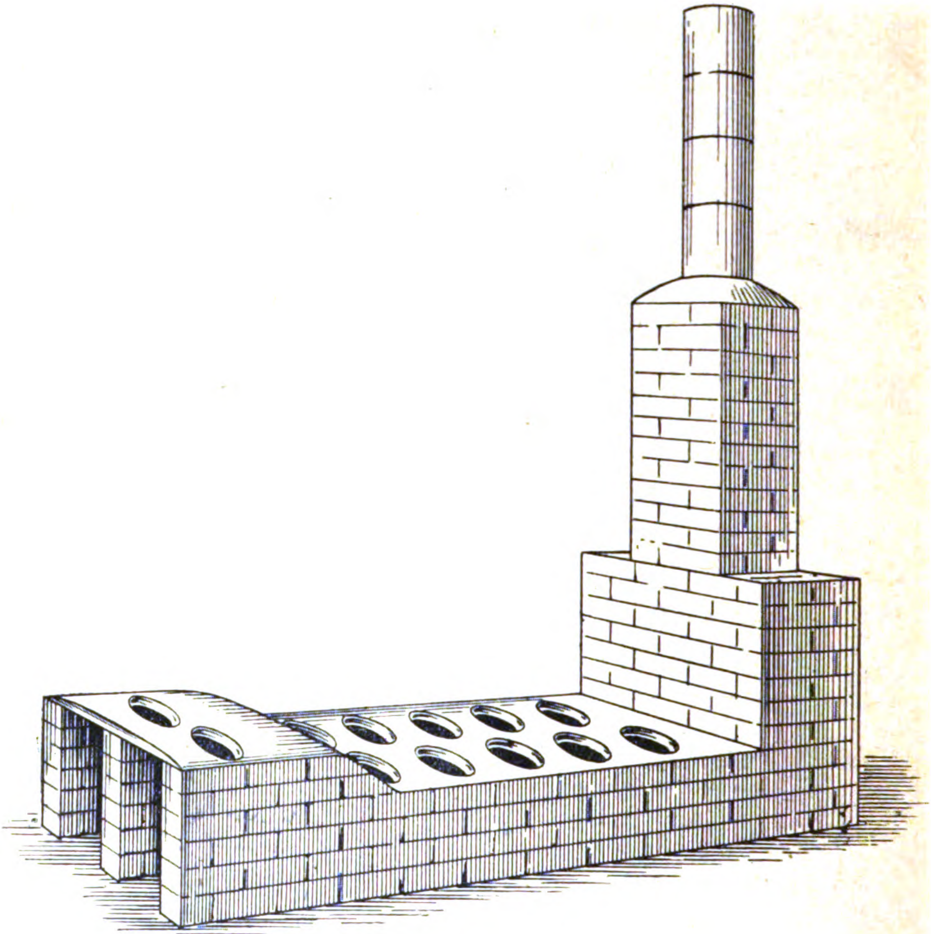

Fig. 2.

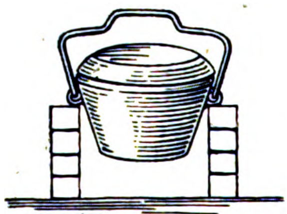

Fig. 3.

had been laid the fire end was raised, for a distance of two feet, by another two bricks. At the chimney end under where the last two kettles would be placed, two small pits (eighteen inches deep) were dug for the disposal of greasy water (see fig. 4). The chimney was then built of brickwork to a height of five feet six inches, and finished off with four paraffin oil drums fitting into one another.

In No. 10 Field Ambulance, Pte. Davies had covered in the channels with a sheet of corrugated iron with oval holes into which the kettles could fit; but as this material was not available the following method was adopted: Strips of iron were rested on the top of the bricks (see

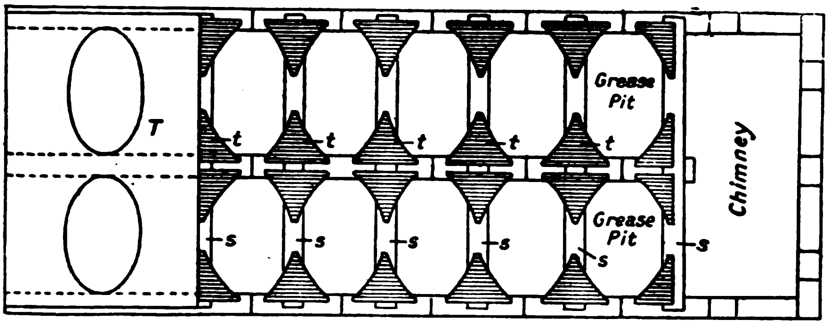

FIG. 4.

fig. 4), the width of a kettle apart and on these, to make the oval shape, were placed triangular pieces of tin (t) cut out of biscuit boxes. The fire end was covered by one sheet of tin with two holes cut in it. The twelve "decksies" were then inserted and the whole "pugged" over with two inches of clay. When this had hardened, the kettles were removed and the structure washed over with lime.

On the fire being lighted all the kettles were boiling in fifteen minutes, and the fine draught caused the flames to pass over the greasy water in the pits, burning up the grease and evaporating the water.

Cracks appeared in the "pug," but by a daily brushing over with "pug paste" when the fires were out, these crevices were closed up and after four months' constant use the clay is almost as hard as cement. The disposal of the greasy water from the cook-house proved a great boon and in the two pits thirty gallons of water were evaporated daily.

The Arrangement for Heating the Ovens.—Fig. 5 roughly conveys the idea as to how the ovens were arranged. "Portable stoves" (as they are designated in the Mobilization Table) go in pairs, the smaller one fitting inside the larger. These were placed in position three inches apart on two courses of brickwork, and leaving eighteen inches between each pair for the fire channel (the row of smaller stoves is on the left, fig. 5). They were then bricked in by building up the front and by

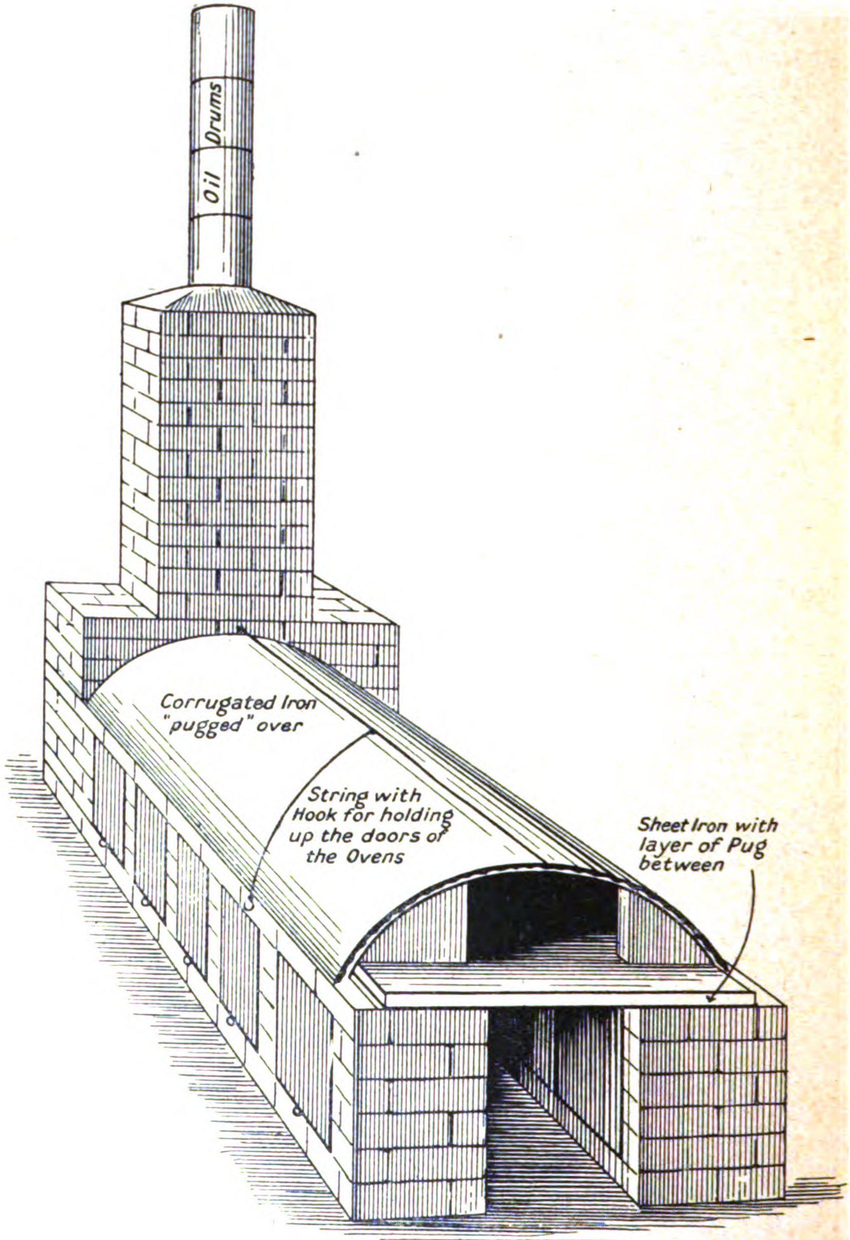

FIG. 5.—Showing the arrangement of the ovens with hot-plate.

placing half bricks edgeways between the stoves. One row of bricks was then laid on the top at the front of the ovens. The plan and elevation of two ovens at this stage may be seen in figs. 6 and 7.

The chimney was then erected consisting of five feet six inches of brickwork surmounted by four oil drums. The hot-plate was next proceeded with. Four sheets of iron were procured from the engineers and placed over the ovens so that they rested on the bricks to leave an air-space of 1½ inches between the top of the ovens and the iron cover. Two sheets of corrugated iron bent over and overlapping in the centre formed the roof of the hot-plate. These were kept in position, as may be seen in fig. 8, by pieces of bent hoop-iron at the chimney and front ends and as an extra support two pieces of brickwork were erected at the entrance.

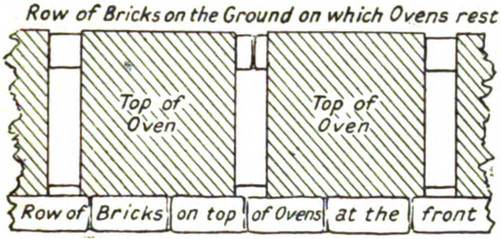

FIG. 6.—Part plan before hot-plate was added.

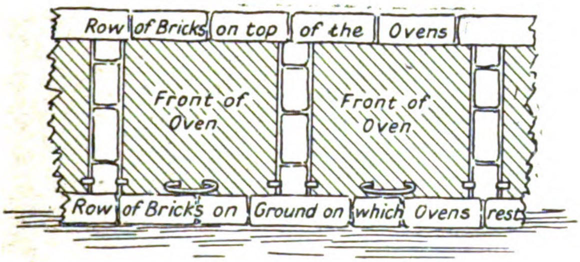

FIG. 7.—Part front elevation before hot-plate was added.

The corrugations were obliterated by a plastering of "pug" leaving a smooth surface. When dry the whole was lime-washed.

The stove has worked admirably. The cook declares he is now ready to provide for 1,000 patients. He has not been called upon to do this but a roast for 500 was easily accomplished.

A grease-pit could have been constructed near the last pair of ovens and the greasy water could have been emptied into it by means of a pipe inserted through the chimney.

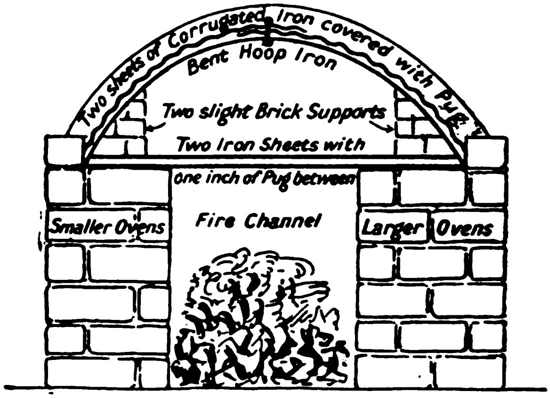

Fig. 8.—Showing method of constructing hot plate.

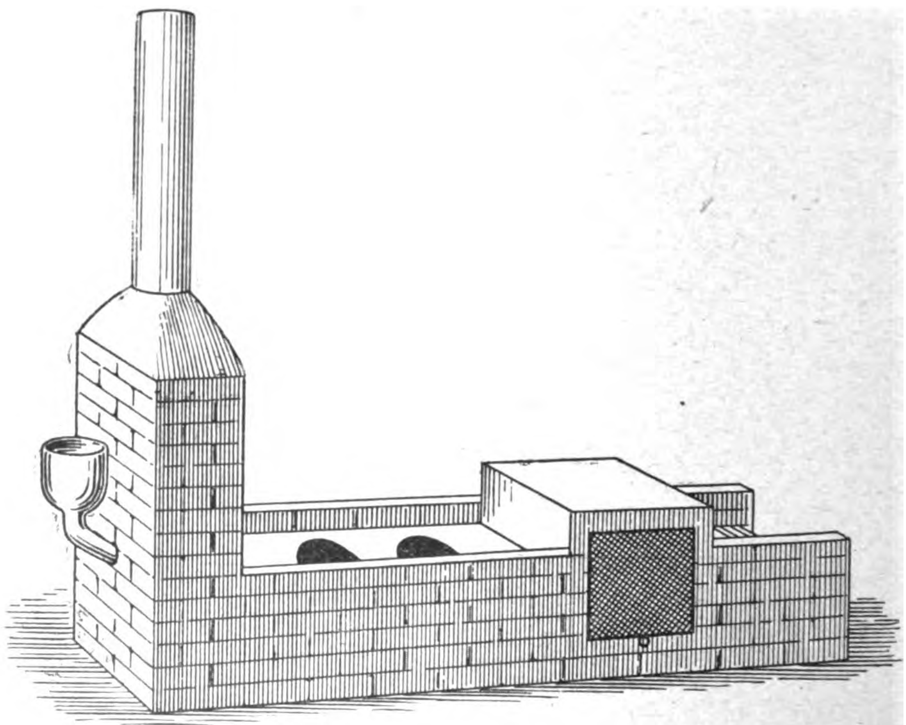

Fig. 9.—Combination stove for heating ovens and kettles and with grease pit for the disposal of greasy water which is poured down the pipe at the back of the chimney.

This idea was carried out in a combination stove built by Serjt.-Major T. Desmond in the grounds of a chateau used as an officers' hospital. The rough sketch, fig. 9, will convey the idea. In this construction, however, which was intended to supply much smaller wants, only three kettles and one "portable stove" were needed. After two courses of brickwork had been laid iron bars were placed so as to support the ovens and the "decksies." In bricking in the stoves an air space was left round the sides and the top (fig. 10). The grease pit was dug, before

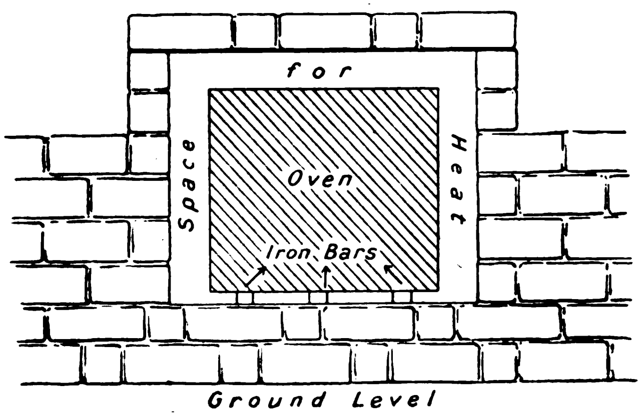

FIG. 10.—Showing bricking in of oven.

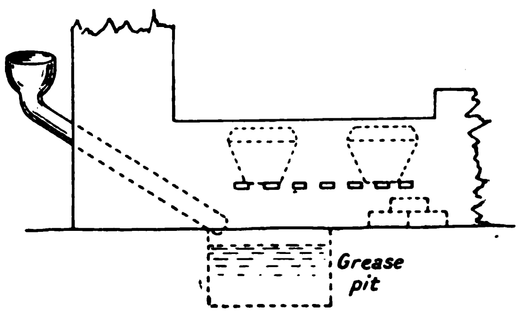

FIG. 11.

covering in, beneath the last kettle to a depth of eighteen inches and a length of stove-pipe with an elbow served to feed it. The construction through the back of the chimney was quite simple (see fig. 11). To prevent cinders falling into the pit a barrier of bricks was placed across the fire channel.

This combination makes a very effective stove but its disadvantage is

that the ovens are always being burned. It was for that reason that it was not adopted at the casualty clearing station, where the kettles are constantly being boiled and the ovens are only in use during the morning.

The above rough descriptions are only a small part of the numberless ingenious contrivances that our men "in the field" have constructed, and of the initiative shown by both the officers and other ranks of the R.A.M.C. during the present war.

LIGATURE OF THE RIGHT INTERNAL ILIAC ARTERY FOR SECONDARY HÆMORRHAGE FROM THE BUTTOCK.

By Captain R. L. SCOTT.
Royal Army Medical Corps.
AND
Lieutenant A. R. McLACHLAN.
Royal Army Medical Corps.

Ligature of the internal iliac for secondary hæmorrhage from the buttock is of sufficient rarity to warrant notice and for that reason we venture to publish details of the following case:—

W. S. was admitted into a base hospital in France on April 29, 1916, suffering from a large shrapnel wound of the right buttock. The wound was septic and plugged with gauze.

Notes from the casualty clearing station stated that considerable bleeding had occurred, which had been treated with gauze plug and pressure. The plug was removed revealing a sinus leading down to the sciatic notch and containing much blood clot. The wound was dressed with eusol, and light gauze packing was introduced.

May 1: General condition of patient showed signs of improvement, but on May 2 and 3 slight hæmorrhage occurred.

May 4: An operation was performed with the intention of securing the bleeding point. The track was explored, clots removed, but no definite bleeding vessel was discovered; merely venous ooze, which stopped after the track was thoroughly washed out.

On account of the depth of the track and the musculature of the buttock it was not considered wise to proceed further, especially as the bleeding had stopped.

Patient continued to improve until May 10 when a slight hæmorrhage occurred, and again at 7.30 p.m. the same day a second hæmorrhage took place and the patient's condition became serious.

A further operation was decided upon and the question arose as to the advisability of ligating the internal iliac by the transperitoneal route or attempting to find the vessel through the gluteal wound.

The ligation of the internal iliac was preferred for the following reasons:—

(1) The absolute necessity of finding and ligating the bleeding vessel, as another hæmorrhage would probably prove fatal.

(2) The difficulty of finding the bleeding vessel deep in a large muscular buttock.

(3) The loss of blood, both venous and arterial, while attempting this.

(4) The possibility of the hæmorrhagic site being intrapelvic.

(5) The disfiguring and disabling effects of cutting through the gluteal muscles in the attempt to open the wound, find the vessels, and the probability of prolonging convalescence.

May 10: Operation. Saline was administered into the axilla through a Lane's transfusion apparatus before operative procedure was commenced, and was continued during the whole of the operation.

A median incision was made from the umbilicus to the pubes. The abdomen was opened and the patient then lowered to the Trendelburg position. The chief difficulty was due to a fatty abdomen with great extraperitoneal fat and a fatty omentum, which obscured the vision, and which necessitated the incision being enlarged to one and a half inches above the umbilicus, in order to allow the intestines to be well packed away in the upper half of the abdomen. The right sacro-iliac synchondrosis was then defined and the ureter and common iliac vessels localized. The posterior layer of the peritoneum was then picked up with forceps, incised, and with blunt dissection the internal iliac artery was defined and the vessel ligated in continuity. The slit in the peritoneum was sewn up and the abdomen closed.

The patient made an uninterrupted recovery with no further hæmorrhage. The abdominal stitches were removed on May 22.

The gluteal wound and patient's general condition improved every day and on June 14 he was sent to England.

As implied from the above, the difficulties in the operation are few. With an ample incision and an acute Trendelburg position, even the difficulty of packing off the intestines becomes comparatively simple. The vessel is easily exposed and the needle can be passed without risk to ureter or vein. There was no necessity in this case to draw any of the intestines out of the abdomen.

A NEW APPARATUS FOR THE TREATMENT OF GUNSHOT FRACTURES OF THE HUMERAL SHAFT.

By Captain G. M. COWPER.
Royal Army Medical Corps.

Compound fractures of the middle third of the humerus would appear still to present considerable difficulty in treatment with regard to satisfactory immobilization and at the same time ease of dressing. In the splint to be described herewith the objective aimed at is the maintenance of the limb in an abducted position with efficient extension of the bone fragments.

Description of Splint.

The apparatus is designed on the principle of the "Middledoff" triangle and is constructed from the malleable aluminium splinting material provided with field fracture boxes. It consists of two shaped pieces (fig. 1), each having a short limb for application to the chest wall and a longer limb for the arm. The one (A) is designed to lie on the front of the arm and chest wall, and one (B) behind, and the two are connected above by a stout shoulder piece (C), and below by an angle piece (D) which is fitted with a notch to which the extension apparatus is attached. A loop (E) is attached to the anterior V for the purpose of supporting and fixing the forearm.

Application of Splint.

Flannel strips (F F) are slung between the shorter ends of the V pieces and these are applied to the chest wall; another strip (G) is slung between the angles of the V pieces and passed under the axilla. The extension (either plaster or gauze and glue), having been applied to the lower fragment, is fixed to the angle piece prepared for the purpose; when it is tightened the purchase is mainly taken from the chest wall and to a less extent from the axilla. The forearm is slung on flannel strips and bandaged into position.

It is usually necessary to tuck in pads of wool between the splint and the chest wall to minimize rubbing.

No further support is really required, the extension keeping the splint in firm apposition to the chest wall.

At the present time we are nursing a case with a badly comminuted fracture of the left humerus at the junction of the upper and middle thirds on this splint. He has three large wounds, one anterior, one lateral, and one posterior, all of which are perfectly accessible with the splint in position. As he is being treated with continuous hypertonic saline "drip" irrigation, no bandages are applied at all and the arm is completely exposed from the axilla to the elbow. This accounts for the slight inward displacement of the upper fragment in the reduced radiogram (fig. 2), which was taken with the splint in position. Since this

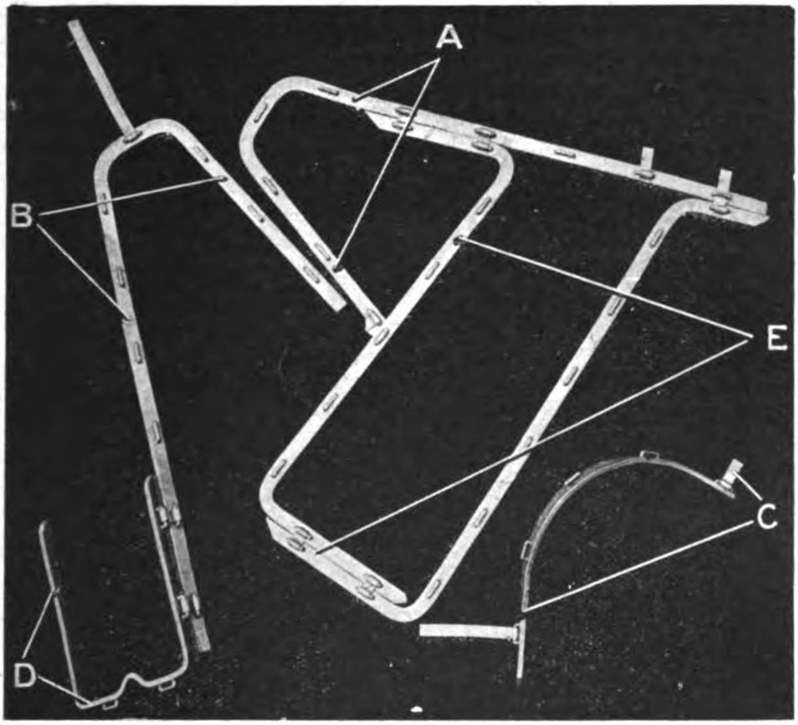

Fig. 1.

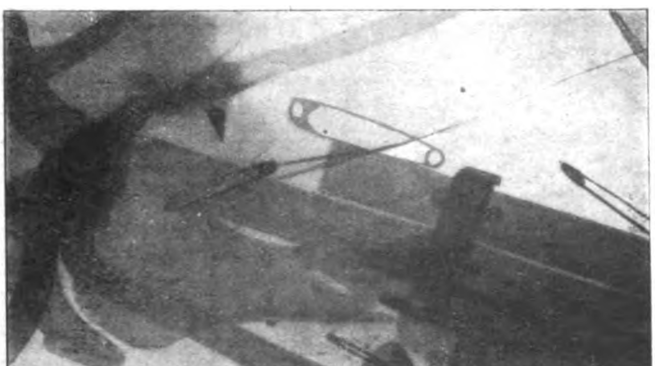

Fig. 2.

splint was applied, ten days ago, the patient has been entirely free from pain or discomfort even when it has been necessary to dress his wounds. In cases where continuous irrigation is not required and dressings can be applied, the employment of flannel strips is desirable to support the fragments and prevent such slight displacements as are evidenced in the accompanying radiogram. If the patient is confined to bed, he should

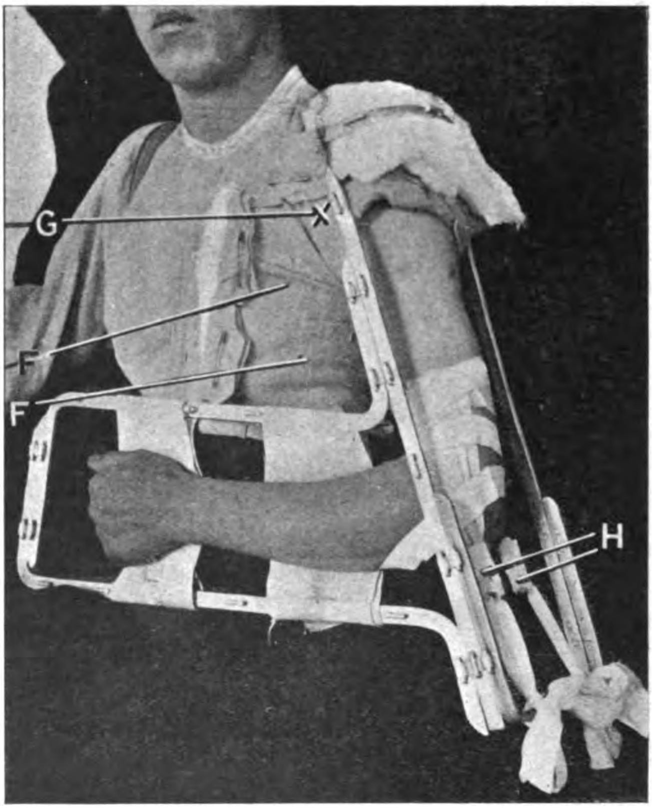

FIG. 3.

be well propped up on a bed-rest; whilst if he is allowed up, the application of a broad supporting binder round the chest is recommended, so as to keep the splint in close apposition to the chest wall.

SUMMARY.

The advantages claimed for this splint are:—

(1) That it maintains the fragments in a position of uniform extension with the limb well abducted from the body, so tending to really good alignment and ease of dressing.

(2) That it allows of passive movements being carried out at the elbow-joint. By undoing the forearm and suitably rotating the splint, movements may be carried out at the elbow-joint without mobilization of the lower fragment.

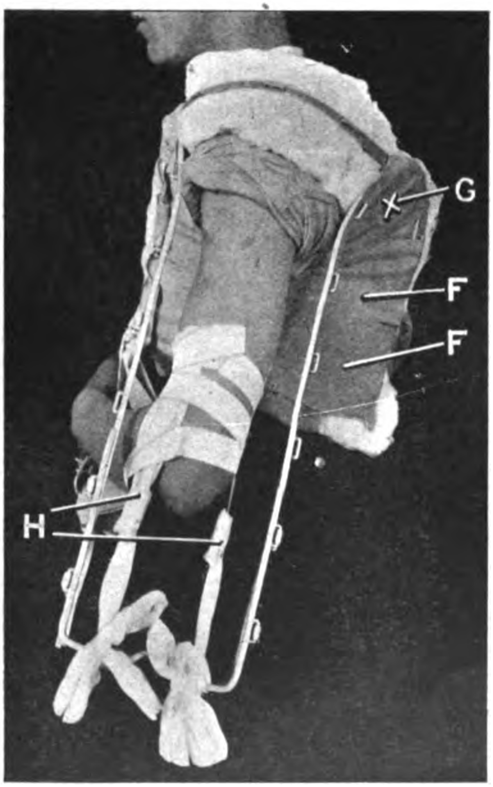

Fig. 4.

Figs. 3 and 4.—Splint applied: counter-extension taken from chest wall (F F) and axilla (G). Extension shown at H.

(3) It is extremely comfortable, especially for travelling purposes.

(4) It is simple to make and very easily and quickly applied. Only one disadvantage has so far been demonstrated, namely that with the splint in position the patient is too wide for a stretcher. This drawback is easily overcome by getting him to lie on the sound side when necessary.

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IMPROVEMENTS IN MOTOR AMBULANCE CONSTRUCTION.

By Brevet Major R. W. D. LESLIE.
Royal Army Medical Corps.
AND
Captain G. A. CHILD.
Royal Army Medical Corps.

Many designs and improvements in motor ambulance construction have been made during the present War, but there are several defects, some of which we have endeavoured to remedy.

Those to which we would call attention are:—

(*a*) Poor seating accommodation; the seats being very low, very narrow, or insufficiently padded.

Fig. 1.—Showing upper tray lowered down with patient in position to be lifted up.

(*b*) The loading of the top stretcher tray, which, on account of its height, is no easy matter, and requires the efforts of several orderlies.

The difficulty of providing a well-padded seat at a comfortable height, and at the same time keeping the under stretcher tray as low as possible has been overcome by means of a collapsible seat.

This seat folds down compactly into the well of the car when not in

use, but, if required, rises automatically when the lower tray is lifted up as shown in photographs. This is accomplished by means of levers fixed to the seat, the under side of the lower tray, and the floor of the ambulance.

It will be noticed that room can be found for ample seat and back padding without necessitating a space being set apart for this between the lower tray and the "overhang" of the ambulance; thus enabling one to place the bottom tray in its lowest possible position.

FIG. 2.—Showing upper tray in course of being raised up.

The second defect mentioned has been overcome by supporting the upper tray on hinged stanchions which permit this tray to be lowered right down on to the lower tray and to project about two feet outside the rear of the ambulance.

A patient on a stretcher can then be placed on it by two bearers and the whole raised up into position quite easily by the same two men.

This method of loading the upper tray is a great improvement, and involves far less risk to the patient and the employment of fewer bearers.

It has often been noticed that a stretcher is unavoidably tilted at a somewhat dangerous angle when lifted up by bearers of different heights, but this risk cannot occur in the method of loading shown.

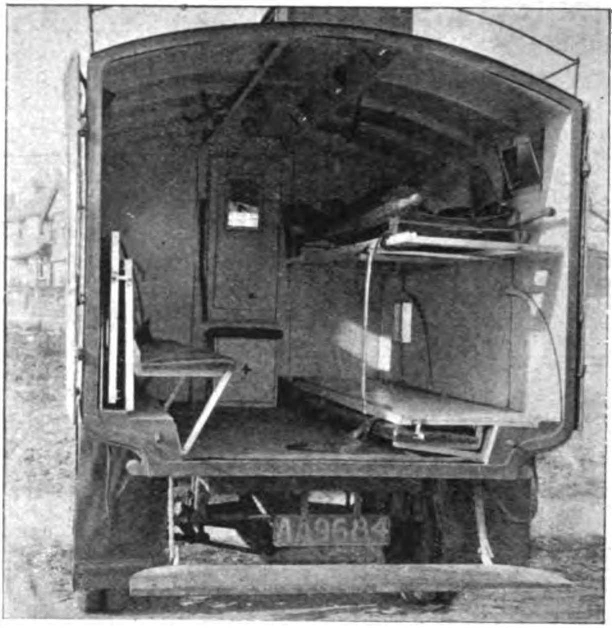


Fig. 3.—Showing upper tray "right up." On the left the trays have been folded up and collapsible seat brought into position.

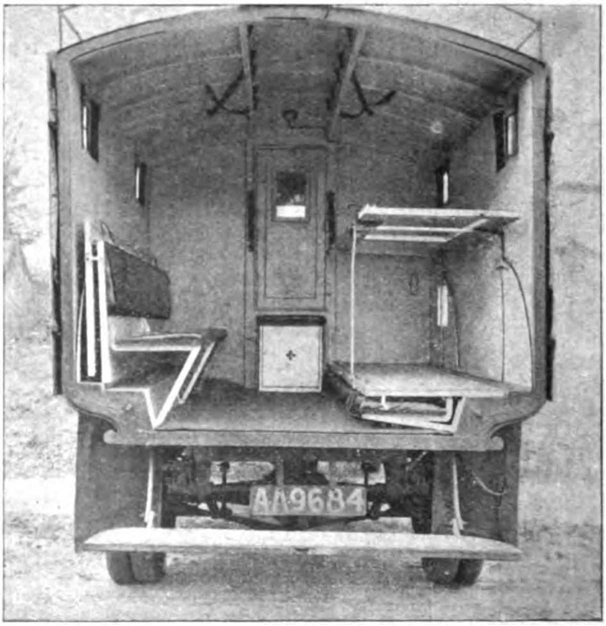


Fig. 4.—Shows ambulance with one side arranged for lying and the other for sitting.

The two improvements described have been made without interfering in any way with the convertibility of the ambulance from lying down to sitting accommodation, or vice versa, as the supporting stanchions of the upper tray are hinged on one side and have detachable joints on the other.

By unfastening the latter the upper tray falls down and the lower tray can then be folded up against it, bringing the seat into position.

Ambulances constructed on these lines have now been in constant use for nearly two years, and have proved in every way successful, having carried several thousands of cases. There are also several minor improvements which may be noticed, such as the method of ventilation by means of hopper windows which can be opened or closed as required, and a useful locker and orderly's seat combined placed below the door communicating between the driver and the interior.

The doors at the back of the ambulance consist of a framework of wood or iron which can be lifted off completely or folded right back against the outside of the car. They are provided with curtains which can be brailed up or down as desired.

A NOTE ON THE OCCURRENCE OF EXPERIMENTAL PARATYPHOID INFECTION IN RABBITS WHICH PROVED FATAL IN EACH CASE, WITH LESIONS RESEMBLING THOSE FOUND IN MAN.

By Captain H. G. GIBSON.
Royal Army Medical Corps.

Having been unable to find any published report on the infection of rabbits with *Bacillus paratyphosus* A in which a pathological picture was produced which so closely resembled that found in man as in this instance, it was thought that a description of the infection might prove of some academical interest.

Altogether three rabbits were infected by inoculating 500 million living *B. paratyphosus* A into the posterior marginal vein of the ear.

Of these rabbits those referred to below as A and B had been inoculated one month previously with 0·5 and one cubic centimetre of mixed typhoid and paratyphoid vaccine with an interval of eight days between the doses; the vaccine containing 1,000 million typhoid bacilli, and 750 million each of paratyphoid bacilli A and B in a cubic centimetre.

Rabbit C was the control rabbit which had not received any vaccine. All the rabbits were inoculated on the same day, and received a 500 million dose from an emulsion of the same twenty-four hour agar slope of *B. paratyphosus* A. Four days later the control rabbit C was found to be suffering from diarrhœa, to be very weak, refusing food, and had lost 120 grammes in weight. On the morning of the fifth day it was found dead in its cage. As it was impossible to make a post-mortem examina-

tion on that day, the body was placed in cold store and a post-mortem performed on the following morning. The body was found to be very emaciated. The spleen was not enlarged, but there was a small infarct present on its anterior surface. The gut was very injected and there was a large typical typhoid ulcer with rolled edges present in the appendix. This had not perforated. This ulcer is of additional interest in view of the recently reported cases of ulcers in the appendices of paratyphoid cases in man.[1]

It was not possible to get a blood culture, but cultures were taken from the gall-bladder and spleen. There was no other macroscopic appearance of disease.

The culture from the spleen proved negative as far as *B. paratyphosus* A was concerned.

From the gall-bladder a Gram-negative motile bacillus was recovered. This on investigation gave the sugar reactions of *B. paratyphosus* A, and was agglutinated by the specific serum which it also absorbed.

Both the rabbits A and B first appeared to be ill six days after the living dose of paratyphosus A. They had both lost weight, were refusing food, and seemed very drowsy.

Rabbit A on the seventh and eighth days was unable to move, was suffering from diarrhœa and refused food. Rabbit B was affected in much the same way but to a less extent.

On the tenth day there was a great improvement in both rabbits, and it seemed likely that they were both going to recover; they were both feeding and hopping about their cages. This improvement was continued on the eleventh, twelfth and thirteenth days. However, on the fourteenth day after infection they both relapsed, and on the fifteenth day rabbit A died.

Rabbit B appeared as if it would not last through the day. Two days later a blood culture was taken from B and proved to be negative; as did a culture taken from the fæces. It is to be regretted that the blood culture was not taken from this rabbit on the day of or on the day following its relapse.

Rabbit B continued to lose weight again but was feeding better until it was found dead in its cage on the twenty-first day after having received the infecting dose.

Post-mortem Findings of Rabbits A and B.

Rabbit A.—This rabbit was opened about an hour after death. It was very emaciated. The spleen was normal. The small intestine was found to be intensely injected and inflamed, though no peritonitis was present. No ulceration could be detected and no other signs of disease were visible to the naked eye. Cultures were taken from the spleen, gall-

[1] "Paratyphoid Fever—A Study of Fatal Cases." Bertrand Dawson and T. H Whittington. *The Quarterly Journal of Medicine*, vol. ix, No. 34, p. 98.

bladder and blood. The cultures from the spleen and gall-bladder both proved sterile.

From the blood a pure culture of *B. paratyphosus* A was recovered. The bacillus was proved by the sugar reactions, agglutinations, and absorption tests.

Rabbit B.—The post-mortem was performed on this rabbit probably some hours after death. Rigor mortis had set in. The body was very emaciated. There were no bowel lesions visible to the naked eye, and no other signs of disease. Cultures were taken from the heart blood and gall-bladder.

The culture from the heart blood was sterile, but *B. paratyphosus* A was recovered from the gall-bladder. The bacillus was proved as in the other cases by the bio-chemical reactions, agglutination and absorption tests.

SUMMARY.

In the case of these three rabbits we have a pathological and in some ways a clinical picture very closely resembling that in man, but in no case was the bacillus recovered from the spleen. The uninoculated control rabbit C died at a time corresponding to the second week of typhoid in man, showing ulceration of the gut and the presence of paratyphoid bacilli in its gall-bladder. It had suffered from loss of weight, diarrhœa, and loss of appetite.

Rabbits A and B both had a longer incubation period than rabbit C, the time being six days. The clinical picture was in each case much the same as C, but they seemed to be recovering from the attack when they both relapsed on the same day, the fourteenth day after infection. Rabbit A died with a renewed bacillæmia on the fifteenth day after intravenous infection.

The question arises as to where the bacilli had been harbouring after the first disappearance from the blood-stream, which takes place very rapidly indeed in the case of rabbits. It seems quite reasonable to suggest that the survival took place in the bile area in the same way that the typhoid bacilli survive in the case of man. Although in this instance the bile culture proved negative it is quite probable that the bacilli would have been recovered if some of the liver had been pulped up and a culture made from that.

This relapse and renewed septicæmia in the rabbit is perhaps the most interesting case of the three.

Rabbit B died of toxæmia on the twenty-first day of the illness, and *B. paratyphosus* A was recovered from its gall-bladder.

The intravenous route of infection of course cuts out the first stage of infection as seen in man, the migration of the bacilli from the gut into the blood-stream, but from this point the course of the disease seems to very closely resemble the human attack.

It has long been recognized that of the three organisms of the enteric

group *B. paratyphosus* A is the most pathogenic for rabbits, and it is not possible to produce the same pathological picture of enterica by the inoculation of *B. typhosus*.

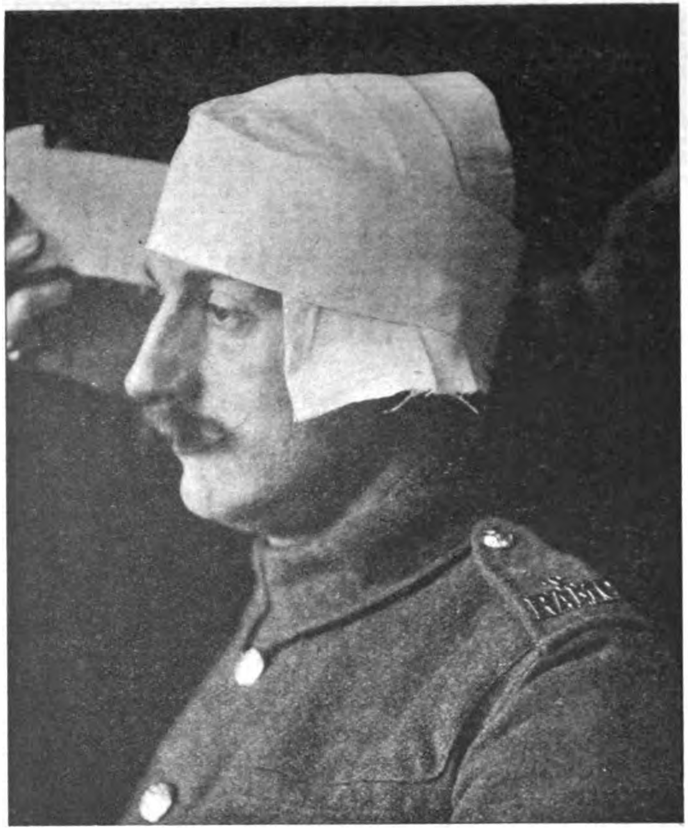
It would appear therefore that while *B. typhosus* is the most fatal of the three organisms for man, *B. paratyphosus* A holds this distinction where rabbits are concerned; also no effect was produced in rabbits with *B. paratyphosus* B in equal doses.

A NEW FORM OF HEAD BANDAGE.

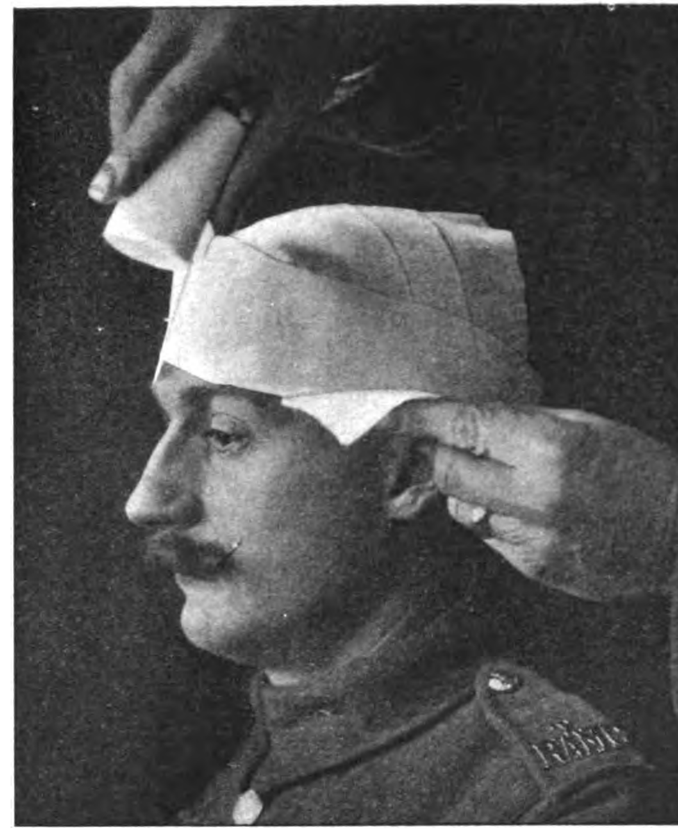
By Captain E. M. JENKINS
Royal Army Medical Corps.

The following prints illustrate a very useful and much needed form of bandages for head injuries, replacing the old and complicated capeline bandage that has been in vogue so many years.

Print 1.—Slips of bandage averaging 16-18 inches are placed over the dressing as in Print 1.



PRINT 2.—You then take a roller bandage, starting the same on right side of the head and give one full turn around, so as to bind the slips down as in Print 2.



PRINT 3.—Continuing the turn until you come to the point shown in print 3. You then take the projecting ends of slips in the left hand and turn them up, so that their edges are almost level with upper end of bandage.

Print 4.—They are now fixed in position by continuing bandage over them, and then over to the other side. When you reach the remaining slips pull them downwards sufficiently to make the dressing firm and secure. Having done this turn up these edges in the same manner as before, binding them down with the bandage. You can then if needed take another turn of bandage around head, finishing up over point where you started, and there pin off.

Print 5.—Shows the same slips applied longitudinally and methods.

The advantages in the application of this new style of bandage have proved of such value that I wish to bring it to the notice of the Royal Army Medical Corps officers, whether in hospitals, etc., or in the various fighting zones, where so many head injuries are brought under their care. They will find it not only of great service but very beneficial to the sufferers. Its advantages are:—

(1) The simplicity of application.

(2) Can be used in any form of head injury, whether severe or otherwise.

(3) It can be used either transversely, or longitudinally.

(4) It can be put on so quickly, which is such an important matter to the wounded, and at the same time a great help to the surgeon, when dealing with a large number of casualties.

(5) It can be applied without causing any undue movement of the head.

(6) It does not produce any discomfort to the sufferer when fixed, as there is no constriction or undue pressure over any part covered by it.

The small amount of bandage required should appeal to all at the present time owing to the enormous amount of material saved by its use.

Even if the whole head has to be bandaged it takes but little more than half a roller bandage—which means a saving of 400 yards in every 1,000 yards of material used.

SOME CASES OF SO-CALLED FUNCTIONAL PARESIS ARISING OUT OF THE WAR AND THEIR TREATMENT.

By Major RAWDON A. VEALE, B.A.Oxon., M.D., B.S.Lond., M.R.C.P.
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Royal Army Medical Corps (T.).

Exact distinction between functional and organic disease is not easy. To say that in cases of functional disorder no pathological lesion can be found is really a confession of ignorance. Doubtless there is some change in the nervous system, but whether the change is a biochemical one, or whether it involves some molecular disturbance in the individual cell, it is, in the present state of our knowledge, impossible to say. Provided that this lack of knowledge is thoroughly appreciated, the distinction between functional and organic disease is a useful one clinically, and this must be the excuse for the title I have chosen.

The causation of such cases has been manifold. The stress and strain of modern warfare; the weariness and exhaustion following the ceaseless vigil of a strenuous campaign; the shock that follows the bursting of high explosive shells; the pains of trench foot or of rheumatism—all have been factors in the production of a series of nervous phenomena, complex

often in their manifestation as in their origin, which for want of a better term we designate as functional. Possibly there is some predisposition—another term for the unknown—in the individual concerned.

These phenomena may exhibit themselves in the complete prostration of the patient, the conversion of what was once a "man" into a mere body without guiding control, with co-ordination between the various centres depressed or entirely gone, or in temporary loss of certain functions such as speech or sight, or hearing or voluntary movement. All grades, all combinations may exist. It is with a particular class of case, with loss of power of movement, with functional paresis, that I wish to deal.

It is remarkable that the majority of these cases of functional disturbance are without any external mark of injury. Just as, to me an old-time simile, if a watch is dropped, and the glass broken, the works often escape injury, so it is with these men. The functional disturbances are entirely out of proportion to the external wounds.

The time of onset has varied in my series. Some of the patients have become "paralysed" within a very short time—a few hours or days or weeks—after their original admission to hospital. In other instances the loss of power has been gradual, and has only appeared after a long course of treatment, perhaps, even, of over-treatment. The lapse of months has resulted in the gradual change from the pains of rheumatism, for example, to the symptoms of paralysis. The subjective symptoms have been converted into objective signs. Doubtless it is much easier to deal with this class of case than with that where there are no such objective signs, where there is a breakdown of the nervous system generally, where emotions have taken the place of a forceful will-power, where the grade of neurasthenia or nervous exhaustion is extreme. Discussion of the treatment of the latter class does not come within the scope of this article. I propose to describe briefly a few cases of the former, and to point out the factors, as far as I can, which led to their recovery.

Case 1.—A. H. This patient was a well-built muscular man, aged 38, who had been nearly twelve years in the regular Army. He was out in Flanders in the first winter of the War, and was sent back to England in January, 1915, with a diagnosis of "trench foot." Subsequently "neuritis" had developed with loss of the power of walking. He had been under treatment at a special hospital since March, 1915, without any real improvement. Various baths, electricity, and massage had been tried. The paraplegia, however, still persisted. For months he had been pushed about in a wheeled chair by kind and sympathizing members of the opposite sex. He came under my care on January 11, 1916. He complained of inability to walk and stand unsupported. There was no wasting of any muscles. The reflexes were greatly exaggerated. He was able to transfer himself by a series of jerky movements to a wheeled chair at the bedside, such movements, or attempted movements, being

accompanied by palpitation, tremors, flushing, and sweating. He was told plainly at the outset that he had now recovered from his "neuritis," and that his condition was simply hysterical. He was not allowed to support himself with the aid of crutch or stick, and the wheeled chair was forbidden. With some difficulty he was persuaded to endeavour to stand alone. At first his efforts only resulted in his flopping on to the bed or floor, and were accompanied by intense psychic phenomena, followed by a period of exhaustion, when he would lie on his bed, taking no notice of his surroundings. In a few days, however, he began to shuffle along the floor, and he was then made to work a stationary bicycle. Improvement rapidly followed, and on January 29 he left the hospital apparently quite well. He expressed himself as very grateful for everything that had been done for him and naively remarked that though at first he considered the treatment rather cruel, it had been subsequently fully justified by the results attained. Duration of stay in hospital was just under three weeks.

Case 2.—G. S., aged 21. This patient sustained a gunshot wound on the left side of the neck in May, 1915. Wound of entrance only. Exit wound not seen. X-rays failed to locate any foreign body. He lost the use of his legs when he had been in hospital a short time. Subsequent treatment—baths, massage, electricity, etc., had failed to bring about any improvement and the patient said he was getting worse.

On admission to the 2nd Northern General Hospital on January 11, 1916, there were no signs of any organic disease. His wound was soundly healed and the scar supple. Attempted movements were accompanied by the usual hysterical phenomena and tears would readily come into the eyes. He was rather a delicate looking lad and appeared a nervous wreck, though he said he was most anxious to get well. The situation was explained to him and exercises were at once commenced. Massage and electricity were discontinued, and treatment was begun on the lines of the previous case. Improvement was very rapid and at the end of ten days the patient left the hospital walking perfectly well.

Case 3.—G. B., aged 24. This patient was admitted on November 29, 1915, complaining that he was suffering from "neuritis and frost bite," He had been in England since February, 1915, and treated at various hospitals with baths, electricity, etc. He asserted that he was unable to walk without acute pain and shuffled along the ward with the aid of two stout sticks, the gift of a sympathizing friend. On being told that there was now nothing whatever the matter with him the patient soon began to walk without the aid of his sticks, which he was not permitted to use. Improvement was rapid. A course of physical exercises was given him and on December 13, 1915, the patient left the hospital carrying his pack and with his sticks under his arm.

Case 4.—G. L., aged 25. Buried in a trench July 23, 1915. Diagnosis: "Injury to back." Had been in no less than seven different hospitals. Admitted to 2nd Northern General Hospital on January 13, 1916.

On admission the patient complained of inability to walk in the erect posture. He moved about the ward with his body bent forward from the hips at an angle of about 30°. There were no signs of any injury or organic disease. When he was made to stand with his back to the wall and gently forced into the upright position tremors at once began in the limbs. He was told that there was now nothing the matter with his back and was made to practise standing upright against the wall. This combined with a little chaff soon produced the desired result, and he left the hospital within a fortnight fully recovered.

Case 5.—G. N., aged 24. This patient was admitted under my care on January 27, 1916. He had been in England since March, 1915. The original condition was one of rheumatism. He now complained of inability to straighten himself or to walk without the aid of artificial support. His gait was a curious lopsided shuffle. His stick was taken away and he was made to perform vigorous exercises. After a considerable amount of persuasion and trouble he was induced to walk quite normally and he left the hospital at the end of one month.

Case 6.—J. K., aged 27. This patient met with an accident in France in April, 1915, in which he was said to have sustained "contusion of the spine." He lost the use of his legs and also sensation in the lower limbs after he had been in hospital a few days. He had to be catheterized on several occasions. He was sent back to England in May and was a patient in various hospitals. He came under my care on January 24, 1916. He was improving but sensation was still impaired. There was marked spinal hyperæsthesia. He was subject to fits of depression and only went out in a bath chair when so inclined. He had been given a spinal jacket. His appetite was capricious and he was sleeping very badly. On examination it was found that there was no wasting of any muscles or pathological alteration in the reflexes. There was some impairment of sensation in both legs in the stocking area. He had been helped in and out of bed. The opinion was formed that the condition was hysterical and the patient himself confessed that he thought "it had something to do with his nerves."

He was at once made to get out of bed and try to walk without the aid of crutches or sticks. At first he would only move about by holding on to the ward furniture, but in a few days he walked alone. His gait for a while was awkward, doubtless from want of practice, but this awkwardness soon wore off, and on February 10 he was able to run. In another week he went on furlough perfectly well.

Case 7.—T. G., aged 25. This patient was admitted with a six months' history of paralysis of the left arm following a trifling injury. The arm hung loosely at his side and the palm sweated freely. There was skin anæsthesia of the whole arm including the shoulder. The muscles reacted normally to both currents and the condition was clearly functional. Varied courses of treatment had already been tried. The

situation was explained to him and every effort made to induce him to move his arm. The limb was held in many positions and supported in them until some involuntary contraction occurred. He was then shown that his muscles were working. Improvement at once began. Physical exercises were given him, dumb-bells, etc. He was made to use the heavy floor polisher, and in a little more than a month the patient was practically well and went on furlough preparatory to return to duty. Sensation returned as use of the arm was regained. The personal superintendence of the exercises given the patient was, as in the other cases, a potent factor in the man's recovery. Although this case seemed to be on the border land of malingering, the patient could not wholly be described as a malingerer. When he was kicking a football about with a number of other men and unaware that he was being watched, if he stumbled his right hand shot out automatically and at first not his left. He had lost the use of his left arm and had to be re-educated.

Case 8.—W. G., aged 23. This patient came under my care on March 14, 1916, with the following history: In the early months of 1915 he had an attack of "rheumatic fever" in which there was some swelling of multiple joints and temperature. The heart was not affected. He was sent back to England on furlough. Before returning to France he complained of pains in the limbs and shortness of breath. He was in consequence admitted to a hospital in England for observation. As no improvement was shown he was sent to a special hospital for a course of baths and electricity. There he remained from August, 1915, to March, 1916. Treatment of a most varied kind was given him—D'Arsonval baths, cataphoresis, electric treatment, massage, etc. Finally he was admitted into the 2nd Northern General Hospital, with a view to being discharged as permanently unfit. When I first saw him he walked or rather shuffled along only with the aid of two crutches. The least exertion brought on most violent tremors, palpitation and sweating. He expressed a wish to take poison if he could not be cured. I told him that his cure would be both rapid and certain. His crutches were taken away and he was at once made to try to walk up and down the ward. At first he had to be supported and he fell on several occasions. In spite of the falls the exercises were continued. All massage was stopped and no drug of any kind was given. As in other cases, his first efforts left him much exhausted but the next day he could stand alone, and in another twenty-four hours he walked by himself. His improvement was thenceforward very rapid and his genuine exertions on his own behalf were much encouraged by the other patients in the ward who took the liveliest interest in the man's recovery. On March 23 he was able to double, and on April 7 he returned to duty, looking a smart and well set-up soldier, in every respect different from the caricature of a man that he presented on his first admission.

The treatment of these cases is based upon the following principles :—

(1) It must be clearly established that the condition is functional and not organic. Of course it is well known to all neurologists that even in cases of definite organic disease there are frequently superimposed symptoms of a functional nature. In such a disease as insular sclerosis, for example, the onset may be preceded or accompanied by functional manifestations. Since the outset of the War it is notorious that the difficulties of distinguishing between functional and organic disease in many cases have been great. Laminectomy has been performed for the relief of supposed spinal pressure and nothing has been found. Post-mortem observations in other instances have failed to reveal naked eye evidence of pathological change where such was unhesitatingly believed to exist. The patient in Case 6 of my series was considered by a surgeon of eminence to have sustained definite injury to the spine. I do not intend to underestimate the difficulties of a diagnosis. As I have said again and again, they are very great. But I do wish to insist on this point. It is far better to label a case as N.Y.D. than to attach an inscription which may not be correct but at any rate is likely to have the effect of alarming the patient and thereby retarding his recovery. As patients are being continually hurried from station to base and from base hospital to England and in England from general to auxiliary hospital and ticketed as they pass, it is not unnatural that those in charge should attempt some diagnosis or classification. With surgical cases for the most part the difficulty does not present itself. Gunshot wound of the leg, with or without fracture, for example, is simple and does not alarm the patient. It tells him exactly what he knows himself and no more. But in medical cases, especially in those we are considering, where a clear diagnosis is very far from being easy, where the symptoms manifest themselves as a disturbance of function or in a series of subjective sensations, the patient is often unnecessarily alarmed by being labelled with a name that suggests a formidable if not incurable disease. Too often is V.D.H. written as the result of a hasty interpretation of a bruit that does not mean organic disease of the heart. Even D.A.H. although it may imply little that is serious to the medical man, exercises a disturbing influence upon the mind of the patient. He cannot, as a layman, be expected to appreciate the significance of a mere functional disorder as such. What he does believe is that there is something the matter with his heart. If he has a weak heart, how is it likely that he will be restored to the fighting line again? At the very outset, when he first comes under medical observation and treatment, instead of hope he is given the *suggestio morbi*. Again, such a diagnosis as "neuritis" to cover the vague indefinite pains, real enough to the patient no doubt, that follow on so many conditions of disease or exhaustion in the present campaign, cannot be sufficiently condemned. In normal times at popular spas the diagnosis may be a source of gratification to the individual who seeks the

"cure" and of relief to the harrassed physician who is asked to name the complaint. But during this War again and again I have seen pain labelled as due to neuritis, when there is not the slightest suggestion clinically of any inflammation. The *suggestio falsi* has merely resulted in the *suppressio*—of a cure. A man is suffering from the results of exposure and hard work in the trenches. Perhaps his recovery is slow. The pains continue. "Neuritis" is diagnosed and the title is attached to the bed-board. The patient begins to think he has an incurable disease and the downward path is begun. *Facilis descensus Averno.*

(2) In the second place the full confidence of the patient must be obtained from the outset. This, perhaps, sounds a mere truism. Still it is surprising sometimes how little has been done to secure this attitude of mind. Confidence does not come all at once, not necessarily at the first or second visit. But it will come if the medical man devotes a sufficiency of time and patience to his task, even in the face of great exasperation. It is not enough to tell a man that he is going to be cured. He must be shown that such a cure is possible. However we may regard these functional cases, even supposing there is an element of malingering, though in my experience this is certainly not frequent, we must all agree that the state of mind is not normal. These men have become as little children and as little children they must be re-educated. They must be taught how to execute simple movements and from simple how to pass on to more complicated actions. I have found it useful on occasions to explain some elementary anatomical fact and even to make use of a simple diagram. One should be careful not to be in too much of a hurry. Let the exercises be gradually extended. Once improvement has begun it is as a rule rapid. The patient has regained his confidence in himself. With this return of confidence he becomes less self-centred and more responsive to treatment. I have said these patients are as children and as children they respond to encouragement, to censure, to praise or blame rightly bestowed.

(3) Drugs are seldom of any avail with the possible exception of an occasional tonic. To dose these men with bromides or the like, as unfortunately is only too often the case, seems to me in the highest degree unscientific. Baths, electricity and massage are in my opinion nearly always useless if not actually harmful. One of my patients complained to me, and I think justly, that "all his manliness had been rubbed out of him." The patient must learn to help himself. His recovery must be active and not passive. On the other hand, I have had very considerable help from the Zander system of mechanical exercises. The ingenuity of these machines interests the patients and they soon realize that it is they who are working them and setting them in motion. They must be watched and encouraged when it is their hour of treatment. Indeed, one has to insist again here that it is the personal factor in the superintendence of these patients that counts for so much.

(4) I think these patients recover much more quickly if they are judiciously interspersed in the general wards. I owe a great deal to the unconscious influence exercised by other men in the ward upon these men. I say unconscious because though they took the greatest interest in these cases they did not know how much they were really helping me. It is nearly always possible to obtain an N.C.O. in the ward to drill these men. I remember one man in particular, an old regular soldier of thirty years' service with a long string of ribbons across his tunic, who though bedridden with bronchitis, regularly held his class each morning in the ward before I went my rounds and duly presented me with his daily report. One man announced to his fellow patients on admission that he was suffering from a paralysed arm. He was given three days in which to get well by an interested spectator. As a matter of fact he recovered within twenty-four hours. The patients, too, stimulate each other. I heard one man telling another, who had sunk back on his bed a trembling, tottering creature, that what he wanted was more confidence, quite oblivious of the fact that he had been just such another a few days previously.

What has become of these men I have not been able to find out. Some have gone back to the trenches perfectly recovered. Some doubtless have not again reached the standard of the A Class. But it is true to say that when they left hospital they left it as men fitted at least to be of some use to their country. Much will depend upon the kind of work they are called on to do. At any rate they returned to duty, fit to play a man's part it may be in their original unit, or it may be in the workshop or at the base. Even if they are unable to stand the strain of military life they are able to make useful citizens in civil life, to be a source of profit to the State rather than a helpless drag upon themselves and an additional burden to the finances of the country. There are many who have been discharged from the service as pensioners who, I believe, had sufficient patience been taken with them on the lines I have tried to indicate, would now be handling rifle or tool instead of cumbering the lists of those harrassed individuals whose duty it is to guard the interests of our discharged or disabled soldiers.

NOTE RECORDING THE PROOF THAT *ANOPHELES MACULIPENNIS* IS AN EFFICIENT HOST OF THE BENIGN TERTIAN MALARIA PARASITE IN ENGLAND.

By Lieutenant-Colonel S. P. JAMES, M.D.
Indian Medical Service.

In a recent official report of an inquiry into indigenous malaria in the neighbourhood of Sheerness, I noted that I had been unable to find zygotes or sporozoites in the stomach and salivary glands of forty-two specimens of *Anopheles maculipennis* caught in huts and bedrooms occupied by patients suffering from locally contracted malaria. Since then I have examined twenty-five more specimens from those dwellings with the same negative result.

For this and other reasons it was desirable to ascertain by experiment whether *A. maculipennis* is an efficient host and carrier of the malaria parasite in England; and on August 30 I made arrangements to carry out this inquiry at the Manor War Hospital, Epsom. The adult female specimens of *A. maculipennis* used in the experiment were brought from Sheerness. On different dates between August 30 and September 15 a benign tertian gamete carrier who had contracted malaria in England, allowed these mosquitoes to feed at the times and in the manner which we knew would be most likely to result successfully. During the period of the experiment the usual precautions were taken to ensure that the patient should not become reinfected by the mosquitoes which he was feeding; and for the same reason I decided not to carry the experiment beyond the stage at which moderately large zygotes could be found in the stomach wall of infected mosquitoes.

On September 15 six specimens remained to be examined, and as, by this time, the daily examination of other specimens had shown that some of them would prove to be infected, I arranged to dissect them in Mr. Barnard's laboratory for microphotography at the Charing Cross Hospital Medical School. This was done in order to secure high magnification photographs of zygotes in their fresh state. The dissections were made on September 17 when the stomachs of the insects were free from blood, and in two out of the six specimens zygotes in different stages of development were present. Under a $\frac{1}{6}$-inch objective and low eyepiece nine large zygotes were counted on one stomach and twelve on the other. As I understood that this was the first occasion on which a successful result in this inquiry had been obtained in England, I telephoned to Sir Ronald Ross, who very kindly came to the laboratory and confirmed the findings before the specimens were handed over for photography.

Report.

REPORT TO THE DIRECTOR-GENERAL MEDICAL SERVICES ON OUR RECENT VISIT TO FRANCE TO STUDY THE CARREL-DAKIN TREATMENT OF WOUNDS.

SIR,—We have the honour to report that in accordance with instructions we visited the following hospitals, and studied in them the methods employed to carry out the Carrel-Dakin treatment of wounds, and the results obtained:—

(1) M. Carrel's Hospital, under the surgical care at the time of our visit of M. Guillot.

(2) M. Tuffier's Clinic, Paris.

(3) M. Chutro's Clinic, Paris.

(4) Mrs. Depew's Hospital at Annel.

(5) The American Ambulance, Paris.

The Carrel Treatment consists in the application at frequent intervals of a gentle stream of fresh antiseptic fluid to the whole surface of an infected wound without any interference with the dressings. It aims at obtaining a reduction in the number of pathogenic organisms in a wound until less than one per "field" in a smear of the discharge can be found with a microscope. Such a wound is regarded as "clinically sterile." When this standard of sterilization of wounds is attained, it is found that they heal rapidly without fever and without the danger of secondary hæmorrhage, and that they can be safely closed, and "primary healing" be obtained. In "clinically sterile" wounds fractures can be safely plated, and comminuted fractures consolidate without necrosis.

The instillation of the antiseptic fluid is effected by means of small rubber tubes, closed at the end, and perforated with six to eight small holes at half-inch intervals; these are placed on or in the wound in such numbers and in such positions that fluid escaping from them is brought into contact with every part of the surface. These tubes are connected with a reservoir containing the selected antiseptic fluid, which is raised about four feet above the patient. By means of an electric clock, of an automatic syphon, or by a nurse loosening a compressor on the supply tube, a given amount of antiseptic fluid is made to flow out through the tubes and over the surface of the wound. As a rule, the fluid is made to pass over the wound every two hours. The interval may be shorter (hourly); rarely is it longer than two hours. The tubes are kept in place by laying sterilized gauze soaked in the antiseptic over them and the whole wound; this deep dressing is covered by dry sterilized gauze, and

over all is placed a larger sterilized outer dressing of non-absorbent cotton wool between two layers of gauze, and this is held in place by a few safety pins. In some clinics a thin inner layer of the outer dressings is made of absorbent gauze and cotton wool. In M. Guillot's and M. Tuffier's wards we saw the dressings renewed every day. In M. Chutro's clinic the inner dressing is changed daily for three days after an operation, and subsequently every second day, and the outer dressing is renewed only about once a week. We did not notice that M. Chutro's less costly practice was attended with any disadvantage.

Every dressing is made by the surgeon himself under the strictest aseptic precautions. Rubber gloves were worn, two pairs of sterilized forceps were used for each patient, and the tubes were placed, the various layers of gauze laid on, and the outer dressing folded round the limb by these forceps, the gloved hand was never allowed to touch either the wound or the dressing. The surgeon was assisted by a large staff of highly trained and careful nurses, each of whom carried out one step only in the preparation for or the conduct of the dressing. Thus one nurse went just ahead of the surgeon and removed the pins from the dressing about to be renewed, and fastened the pins in each dressing as it was completed; a second nurse attended to the "smears," a third to the "combs," a fourth to the vaseline, a fifth handed the fresh outer dressings and the "sister" handed the forceps to the surgeon and then handed him the tubes and the wet and the dry gauze as he required them. This made the technique elaborate, and the process rapid. Since our return home we have found it possible to carry out the dressings with two or at most three trained helpers, and without any undue lengthening of the "dressings."

In MM. Tuffier's and Guillot's wards a "smear" is taken from each wound every second day, the number of organisms per "microscope field" is carefully determined by a skilled observer and is recorded on a bacteria chart, which is kept with the patient's temperature and pulse chart. When the bacteria chart shows a "count" of less than one organism per field on three successive occasions, the wound is considered "clinically sterile," and suitable for closure by operative measures. We saw several cases where such closure had been carried out with success. *The making of these bacteriological observations and counts is essential if the surgeon desire to practise secondary closure of infected wounds.* The charts also afford a valuable index of the success of the antiseptic treatment of the wound. In the cases we saw, there was almost invariably a rapid fall of the chart line from "infinity" or from a very high count to under ten bacteria per field, and most of the wounds soon became nearly or quite "clinically sterile." In M. Chutro's clinic, the treatment is carried out on rather simpler lines. In a large number of his cases, no bacteria chart is kept and smears are examined only once in ten days. M. Chutro does not practise closure of formerly infected

wounds, and he is therefore not dependent upon a definite assurance that a wound is "clinically sterile." He is satisfied if there is no suppuration in a wound, if it steadily heals, and if the patient's general condition is good and the temperature normal.

Provision has to be made against the patient's bed becoming wet from the fluid running out above or below the dressing, or soaking through it. We saw different means used to prevent this.

(1) In some cases a large mackintosh sheet covered with a draw-sheet was placed beneath and far beyond the dressing, and the draw-sheet was changed as soon as it became wet. In some cases the outer dressing became so wet that it had to be changed between the surgeon's daily visits; this resulted from allowing an excessive amount of the antiseptic fluid to flow over the wound.

(2) In M. Chutro's wards we saw large shallow zinc trays placed beneath the wounded limb or part of the body. The fluid that escaped into these trays was led through a tube into bottles beneath the beds.

The patient's back or wounded limb was supported on a large rubber air-cushion; the men appeared to be quite comfortable, and assured us this was so. The wetting of the dressings causes really very little inconvenience when the amount of fluid flowing over the wound is well-regulated.

(3) We have found large pads of sphagnum moss placed beneath the wound a very simple and at the same time an effective means of avoiding this dampness.

It is recognized by all who use Dakin's fluid or eusol, that it sometimes causes irritation around the wound. MM. Tuffier and Guillot guard against this in all cases by covering the skin for some distance beyond the wound with a layer of gauze soaked in sterilized vaseline. M. Chutro only applies the vaseline when he sees evidence of irritation of the skin, and then he puts it on thickly by means of a sterilized wooden spatula. This is a real difficulty, and *must* be guarded against. M. Chutro's plan is the simpler of the two, and is certainly effective. We did not see any serious consequences from this irritation of the skin.

In M. Carrel's clinic, Dakin's fluid is invariably used as the antiseptic of choice. When a wound has become a superficial and a healthy granulating wound, it is usually dressed with chloramine ointment, composed of chloramine ten parts, stearate of soda eighty-six parts and water four parts. The percentage of chloramine may be increased to twelve or reduced to six. Experiments were being carried out to determine which of the many chloramines is the best to use for this purpose.

In M. Tuffier's clinic and in M. Chutro's clinic only Dakin's fluid is used in carrying out this treatment. M. Chutro with a clinic of 300 military beds into which he asks for the "worst cases" to be sent, uses no other antiseptic at any stage of the healing of a wound. When it has become quite superficial and is in the condition in which we saw chlora-

mine ointment used by M. Guillot, M. Chutro covers the wound with a layer of wet gauze, upon this he lays a Carrel tube and over that more wet gauze and surrounds the part with the usual outer dressing. Many of M. Chutro's cases are very chronic and have been suppurating for months and are frequently complicated with necrosis.

In the Annel Hospital we saw three fluids used with Carrel's tubes—Dakin's fluid, eusol and ether. We were assured that good results were obtained from each of them. One of the surgeons, M. Lefebre, expressed a preference for ether. One advantage of ether over other antiseptics is that the outer dressing does not become wet and can often be left untouched for four days. On the other hand, ether is a costly antiseptic, and some of the patients complained of the intense cold its instillation caused. In this hospital the majority of the cases were recent wounds, and many patients arrived within a few hours of being wounded. Such cases are the least severe test of any antiseptic method.

It is evident that in estimating the value of the Carrel-Dakin treatment care must be taken to appraise quite separately the method of applying the antiseptic and the antiseptic employed. While convinced that the use of Carrel's tubes as we saw them employed is a very valuable means of applying an antiseptic fluid to a wound, we are not satisfied that Dakin's fluid is markedly superior to eusol, and we are prepared to find that other antiseptics can be used with advantage by the Carrel method.

The results of the Carrel-Dakin treatment as seen by us in a large series of unselected cases were strikingly good.

(1) The bacteria chart usually showed a rapid fall in the number of bacteria present in the discharge. The more recent the wound the more rapid this fall; in some cases of long-standing infection, particularly in sinuous or pouched or irregular wounds in which there was physical difficulty in bringing the fresh antiseptic into contact with every part of the wound, the fall in the bacteria chart might be long delayed. The presence of a sequestrum or of a foreign body similarly delayed the sterilizing of a wound. M. Tuffier said, "I can sterilize any wound by this treatment." We saw many charts in which the number of bacteria in the smears examined was given as less than one per field (clinical sterility). An operation was often immediately followed for two or three days by a rise in the bacteria count, and this was particularly observed where a layer of blood clot had been left in the wound; great care was, therefore, taken to arrest all oozing from a wound at the time of operation. Anaerobic bacteria were reduced in numbers as quickly as the aerobic, but streptococci were more resistant than staphylococci. We were told of a case in which an operation was carried out in a wound which was the seat of erysipelas, and the result was satisfactory.

(2) We saw several cases where infected wounds had become "clinically sterile" under this treatment, and had then been closed by

the surgeon, and had healed by primary union. In some of these cases cavities in bone due to comminuted fracture or to chronic osteomyelitis and necrosis, had been filled with a graft of subcutaneous fat taken from the patient, the skin edges had then been undermined and sewn together over the graft. Primary union had been obtained and consolidation of the bone had occurred later on. Great stress was laid by all the surgeons we saw upon the necessity of demonstrating in the laboratory the "clinical sterility" of a wound before attempting its closure. Clinical evidence alone is not to be relied upon. Only wounds proved to be practically germ-free ought to be dealt with in this way. We think it desirable to lay special stress upon this point.

(3) In one of M. Tuffier's wards we saw a series of cases of chronic empyema, nearly all of them resulting from gunshot wounds many months before admission. By Carrel-Dakin treatment "clinical sterilization" of the cavity had been obtained, and when this fact had been demonstrated, M. Tuffier had raised the edges of the wound from the ribs, sutured them, and obtained primary union, although there was still a considerable cavity in the pleura unobliterated. We examined these cases and found that they were well, with firmly healed scars. Post-pneumonic empyemata are treated in a similar way and healing is often obtained, we were told, in two or three weeks.

(4) We saw a large number of serious wounds from gunshot injuries, treated by the Carrel-Dakin method, in which there was no suppuration. Among these were many cases of compound fracture of the pelvis, femur, tibia, and humerus, wounds of the hip, knee, ankle and shoulder joints, as well as chronic osteomyelitis of various bones. In M. Chutro's large clinic, for example, we only saw recognizable pus in two cases, in each of these cases the ends of long and deep wounds had been sutured and tubes had been placed in the open central part. Suppuration had occurred at one end, and was treated by removing the sutures and putting more Carrel tubes into the wound. In cases of badly united fractures of the femur with shortening and infected sinuses, M. Chutro did not hesitate to divide the bone to obtain proper alignment of the fragments. By heavy extension and Carrel-Dakin treatment of the wound, he obtained a clean granulating wound and rapid consolidation of the bone.

(5) The wounds granulated well, the granulations were even and florid, and so far as we could judge, healing progressed rapidly.

(6) The patients looked well, and were free from fever as soon as the bacteria count fell. They were free from pain and made no complaint of the method of treatment. The change of dressing was generally quite painless, and the instillation of the fluid caused at most a sensation of coldness, but no pain. We noticed that after operations in which bone had been removed, and tubes and gauze had been placed in contact with raw osseous tissue, they were not removed for some days (four days for the tibia, six for the femur) and in this way the pain

caused by early removal was avoided. We saw one case where the change of the deep dressing in a wound of the ankle caused severe pain, necessitating on one occasion the administration of a general anæsthetic. This was said to be due to the exposure of the posterior tibial nerve in the wound.

(7) The most striking evidence of the value of the treatment that we saw was a printed notice put up in a prominent place in M. Tuffier's wards, and to which he drew our special attention, as being the expression of his own opinion after a considerable experience of the Carrel-Dakin treatment. The notice is as follows:—

"TOUT BLESSÉ QUI SUPPURE A LE DROIT D'EN DEMANDER LA RAISON A SON CHIRURGEON."

Certain objections have been raised to this treatment.

(1) It requires the personal attention of the surgeon in charge of the case to each individual patient. This undoubtedly lessens the number of cases that a surgeon can take under his care. M. Chutro estimated that fifty or sixty patients per diem was as many as a surgeon could properly attend to. As a set-off to this, it must be pointed out that patients gain considerably by being always dressed by the surgeon in charge of them.

(2) The technique is more elaborate than that of most wound dressings, and as we saw it carried out, entails a heavy strain upon the nursing staff. The dressing is, however, only changed once in twenty-four or forty-eight hours, and when once dressed, the wound requires very little attention for the rest of the time. If an automatic flushing system is employed, all the nurse has to do is to see that the reservoir is filled at stated intervals, that the bed does not get wet, and that the movement of the patient and the arranging of the bed clothes does not disturb the tube. We have found that it is quite practicable to carry out the system of treatment with two nurses only in attendance upon the surgeon, and that when once the routine is learned, cases can be dressed very expeditiously; nurses state that the work of the ward is not heavier under this system than under others.

(3) It has been alleged that the flushing of the wound every two hours with the antiseptic fluid is disturbing, or even painful, to the patient. We find that at the commencement of the treatment this may be so, but in a very short time the flushing does not wake the patient from sleep, nor does it cause anything more than a passing sensation in the wound when awake.

(4) *Expense.*—We are not able to give a definite comparison between the actual cost of a series of patients treated by the Carrel-Dakin system and a similar series of patients treated by other means. Much of the equipment can be used for patient after patient. The rubber tubes can be cleansed and re-sterilized, and safely used again. The outer dressings

oftentimes last a week, and as they are made of unbleached and non-absorbent wool, they cost very much less than dressings of similar size of absorbent wool. Care in the use of these dressings, and the supplementing of them by almost countless sphagnum moss pads reduces the cost very considerably, and we think must make it less than some forms of dressing, particularly those involving the employment of large quantities of absorbent wool.

(5) *Difficulty in preparing the Fluid.*—Eusol is easily prepared and in hospitals where large quantities are needed it can be made fresh every day, and always be of its proper potency. Dakin's fluid is more difficult to prepare, and its preparation has to be carried out with great precision if its proper composition is to be maintained. We give as an appendix to this report the method of preparation recommended by one of our number, Captain Attwater. We do not feel able or called upon to state whether there is such proved superiority of Dakin's fluid over eusol as to justify its invariable use. It is important that these fluids should be protected from the action of light and of heat, but this is easily done.

(6) These objections are one and all of small amount when compared with the proved advantages of the Carrel method of treatment. The prevention or arrest of infection of the wound, the greater rapidity of healing, more than repay for any labour or cost that the method involves.

(7) If the system is adoped at casualty clearing stations and base hospitals, provision must be made for the continuance of the irrigation of wounds during the transit of the patient from place to place. If the method is employed at all, it should be employed in its entirety; it is not enough to introduce tubes into a wound and envelop the limb in a non-absorbent dressing, and then to send the patient away on a long journey where there may be no facilities for keeping up the instillation of the antiseptic fluid.

We are of opinion that the Carrel-Dakin method of treatment, if carried out thoroughly, is full of promise, and we believe that it will (1) diminish the dangers incidental to sepsis, including secondary hæmorrhage, (2) hasten the patient's convalescence, (3) lessen the liability to stiff joints and cicatricial deformities, (4) enable the patients to leave the hospital with better general health than they otherwise might, and (5) where secondary operations become necessary, these operations are more likely to be free from septic complications than where some other system of primary treatment has been adopted.

ALFRED PEARCE GOULD.

Signed on behalf of

Lieutenant-Colonel Sir Alfred Pearce Gould.
Lieutenant-Colonel Sir Thomas Myles, C.B.
Lieutenant-Colonel Albert Carless.
Captain Attwater.
Captain Beesley.
Captain Douglas-Crawford.

APPENDIX.

BY CAPTAIN ATTWATER.

PREPARATION OF DAKIN'S SOLUTION.

(Technique of Dr. Daufresne.)

Dakin's solution is a solution of hypochlorite of soda prepared for surgical use, the characteristics of which, established after numerous trials and long experience in using, are as follows :—

(*a*) Entire absence of caustic alkali. It is absolutely necessary to employ for the treatment of wounds a solution of hypochlorite free from caustic soda; therefore one must completely eliminate "eaux de javel" of commerce and labarraques, and all solutions prepared by other process than the one given here.

(*b*) Concentration of hypochlorite of soda must be between 0·45 to 0·5 per cent. Under 0·45 per cent of hypochlorite, the solution is not sufficiently active, and over 0·5 per cent it becomes irritant.

CHEMICAL PRODUCTS NECESSARY FOR THE PREPARATION OF THE SOLUTION.

The three products necessary in making Dakin's solution are :—

(1) Chloride of lime (bleaching powder).

(2) Dry carbonate of soda.

(3) Bicarbonate of soda.

Of the three products the last two practically offer a sufficiently uniform composition, but this is not true of the first (chloride of lime) which contains active chlorine in very large and variable proportions, and therefore must be titrated before using.

(1) See appendix.

(2) This product is easily found on the market under the name of soda "solvay" or "soda carbonate of solvay"; it is the purest sodium carbonate and never contains caustic soda. If one positively cannot get it, and only obtains the crystallized carbonate (washing soda) it would be necessary (on account of the water of crystallization) to employ 2·85 times more of this carbonate than of the dry salt.

Titration of the Chloride of Lime.—To make the titration of the chloride of lime one must have: (1) a binks burette graduated in $\frac{1}{10}$ of a cubic centimetre; (2) a graduated pipette of ten cubic centimetres; (3) a decinormal solution of sodium hyposulphite. This decinormal solution of hyposulphite can be obtained on the market, but one can prepare it by dissolving twenty-five grammes of pure crystallized hyposulphite of soda in one litre of distilled water and verifying that this solution discolours an equal volume of decinormal solution of iodine. The decinormal solution of iodine is obtained by dissolving in 100 cubic centimetres of water, 1·27 grammes of iodine and 5 grammes of potassium iodide.

Technique of the Titration.

Take from different parts of the jar a small quantity of bleaching powder in order to have a uniform sample; weigh exactly twenty grammes of it, and mix as well as possible in a litre of water. Leave in contact a few hours. Filter.

Measure exactly 10 cubic centimetres of the clear liquid and add 20 cubic centimetres of a 10 per cent solution of potassium iodide, 2 cubic centimetres of acetic or hydrochloric acid, then put in drop by drop into the mixture a decinormal solution of sodium hyposulphite until decoloration.

The number of cubic centimetres of hyposulphite employed, multiplied by 1·775 will give the weight of active chlorine contained in 100 grammes of chloride of lime.

This total being known, refer to the following table which gives the quantities of chloride of lime, carbonate, and bicarbonate of soda which must be employed to prepare ten litres of Dakin's solution.

Percentage in active chlorine of the chloride of lime	Quantities of ingredients to use for preparing ten litres of Dakin's solution at 0·475 per cent of ClONa		
	Chloride of lime	Dry sodium carbonate	Sodium bicarbonate
20	230 gr.	115 gr.	96 gr.
21	220 ,,	110 ,,	92 ,,
22	210 ,,	105 ,,	88 ,,
23	200 ,,	100 ,,	84 ,,
24	192 ,,	96 ,,	80 ,,
25	184 ,,	92 ,,	76 ,,
26	177 ,,	89 ,,	72 ,,
27	170 ,,	85 ,,	70 ,,
28	164 ,,	82 ,,	68 ,,
29	159 ,,	80 ,,	66 ,,
30	154 ,,	77 ,,	64 ,,
31	148 ,,	74 ,,	62 ,,
32	144 ,,	72 ,,	60 ,,
33	140 ,,	70 ,,	59 ,,
34	136 ,,	68 ,,	57 ,,
35	132 ,,	66 ,,	55 ,,
36	128 ,,	64 ,,	53 ,,
37	124 ,,	62 ,,	52 ,,

Example.—If it was necessary to use 16·6 cubic centimetres of the decinormal solution of hyposulphite to obtain discoloration, the percentage of active chlorine in the chloride of lime is 16·6 × 1·775 = 29·7 per cent.

The quantities of the ingredients to employ for the preparation of ten litres of the solution, in this case, would be :—

Chloride of lime	154 grammes
Carbonate of soda, *dry*	77 ,,
Bicarbonate of soda	64 ,,

and if one has only the carbonate of soda in crystal form, it would be necessary to replace the 77 grammes of dry carbonate by 220 grammes of crystals.

Preparation of Dakin's Solution.—For preparation of ten litres of solution.

(*a*) Weigh exactly the quantities of chloride of lime, sodium carbonate, and sodium bicarbonate determined in the former way.

(*b*) Put into a twelve litre flask the chloride of lime and five litres of cold ordinary water (not distilled water), shake vigorously for a few minutes and leave in contact for six to twelve hours, one night for example.

(*c*) At the same time dissolve in five litres of cold ordinary water the carbonate and bicarbonate of soda.

(*d*) Pour the salt solution into the flask containing the macerated chloride of lime, shake vigorously for a few seconds and wait to allow the calcium carbonate to be precipitated. After about half an hour syphon the liquid and filter with a double filter paper to obtain a good clear liquid.

Conservation.—The Dakin's solution must be kept in a dark place because light destroys the sodium hypochlorite rapidly, and it is indispensable to preserve from the action of light the solutions which have to be kept for some time. A very good device for the conservation of the solution consists in keeping it in big wicker covered dark green bottles, and the addition of five milligrammes of potassium permanganate to each litre stabilizes the hypochlorite.

Titration of the Dakin's Solution.—It is prudent to verify from time to time the percentage of the solution. This is done absolutely like the titration of the chloride of lime:—

Measure 10 cubic centimetres of the solution, add 20 cubic centimetres of a solution of ten per cent potassium iodide, 2 cubic centimetres of acetic acid and add drop by drop a decinormal solution of sodium hyposulphite until discoloration. The number of cubic centimetres used multiplied by 0·03725 gives the weight of hypochlorite of soda contained in 100 cubic centimetres of the solution.

The Dakin's solution is of proper strength when it is necessary to use for discoloration twelve to thirteen cubic centimetres of hyposulphite solution.

$$13 \times 0{\cdot}03725 = 0{\cdot}485 \text{ per cent ClONa}$$

Test of the Alkalinity of the Dakin's Solution.—To easily differentiate the solution obtained by this process from the commercial hypochlorites.

Pour into a glass about twenty cubic centimetres of the solution and drop upon the surface of the liquid a few centigrammes of phenolphthaline *in powder;* the correct solution does not give any coloration, while labarraques and eau de javel give an intense red coloration which shows in the last two solutions the existence of free caustic alkali.

Appendix.

If the quantity of solution has to be manufactured on a large scale it has been found useful to adopt the following method of procedure.

The absolute accuracy laid down by Dr. Daufresne must be insisted upon.

The first thing to be done, at the beginning of the day, is to commence the test for the chlorine content of the bleaching powder. The approximate amount of bleaching powder, required for the following day is placed in a large stoneware trough with an opening in the bottom which can be closed with a rubber or cork bung. Care is taken to mix the powder thoroughly and to break up large lumps with a pestle.

The test sample is taken from this and placed in a wide-mouthed glass-stoppered bottle. The bung is then removed from the bottom of the mixing trough, and the remainder of the powder is allowed to fall through into a wide-mouthed stoneware jar, which can be closed by a large cork. It is then put aside until the evening, when it is made into solution for the following day.

Twenty grammes of the test sample are then weighed out accurately on the balance and a solution made up to one litre as previously described.

It is advisable to have some 100 grammes in the test sample as it may be necessary to verify results next day if errors occur.

The litre of test solution with occasional shakings stands till evening.

The chemist then takes the carbonate solution and the bleaching powder solution which were prepared the previous evening and adds them together, being careful to pour the carbonate solution into the bleaching powder solution and not vice versa. These are left in contact for about an hour with occasional shakings and stirrings.

The lime residue is then allowed to settle and the supernatant liquid is syphoned off into a clean carboy after about a quarter of an hour. By this means irregularities in the strength of the Dakin's solution are avoided, because the lower layers of the solution in the carboy are apt to become slightly different in strength owing to prolonged contact with the lime residue.

The solution is then filtered through filter papers, a large number of four inch to five inch enamelled iron funnels being employed so as to increase the rate of filtration. Large funnels are unsuitable owing to the liability of the filter papers to breakage.

The solution is filtered into half gallon jars for distribution, care being taken to see that no filter paper breaks, though with ordinary care this does not happen.

A sample of the solution is tested at the beginning and at the end of filtration, and the resulting strength, together with the date of manufacture, noted on a label and gummed on the jar. The test for alkalinity is also made.

In the evening the test solution of bleaching powder is titrated as described, and the necessary weights of bleaching powder, sodium

carbonate, and sodium bicarbonate for the following day's supply are calculated.

The solution is divided up into ten-gallon portions, because a ten-gallon carboy when full is about the maximum size that an able-bodied person can handle for shaking, stirring, washing, etc.

The necessary amount of bleaching powder is placed in as many ten-gallon carboys as wanted, and water added to bring the amount of solution in each up to five gallons.[1] This with the five gallons of carbonate solution will give the ten gallons of Dakin's solution.

The necessary amounts of carbonate and bicarbonate solution is also made. It is advisable to make up the sodium carbonate in a relatively small quantity of hot water, otherwise solution is slow; cool this and then add the bicarbonate. The latter must never be put into hot water, otherwise it rapidly undergoes chemical decomposition.

As long as the chemist is in the laboratory he gives the solution of bleaching powder a shake from time to time, and then leaves it to macerate for the night.

Strength of Dakin's Solution.—It is absolutely essential, if results are to be had comparable to those obtained by the workers in France, that the strength of the solution must be between 0·50 and 0·45 per cent NaOCl. One authority, Professor Chutro, who is using the treatment on a very

---

[1] How to bring a Solution of Bleaching Powder in a Ten Gallon Carboy, the Inside of which Cannot be Seen, up to Five Gallons.

Five gallons of water are carefully measured into the carboy, which bears a distinctive number. A mark is scratched on the top of the neck of the carboy, which is then placed under a horizontal beam, either a permanent fixture or mounted on two upright legs of sufficient rigidity so that the apparatus may undergo no distortion by handling.

The distance from the lower surface of the beam to the mark on the carboy is then carefully measured. A small gauge indiarubber tube is then dropped to the bottom of the carboy and connected with a long glass manometer U-tube and the water is then carefully sucked over into the tube.

Then the level of the water in the distal limb of the U-tube, subject to a correction for capillary attraction, which being the same for all levels in a uniform tube may be neglected, gives the height of the water in the carboy.

It is now quite simple to make five gallons of bleaching powder solution. The powder is placed in the empty carboy and three or four gallons of water added. The carboy is then placed under the horizontal beam and the distance from the mark on the neck to the under surface of the beam measured, this is practically constant for any individual carboy, and only depends on inequalities on the floor and movements of the carboy in its casing; it must be checked, however, each time of using and a simple correction made. The manometer is then filled and by adding water to the carboy, until the water in the manometer reaches a mark at the required distance below the horizontal beam, five gallons of solution are obtained.

As a matter of practice in making all solutions of bleaching powder, it is advisable to make a very strong solution first and then dilute, otherwise large portions cling together in solid lumps and float about, refusing to break up.

large scale, uses a solution between 0·47 and 0·45 per cent hypochlorite of soda.

The Chemistry of the Solution.—The result of mixing the carbonate solution with the bleaching powder solution is probably represented by the following formula:—

$2CaOCl_2 + Na_2CO_3 + 2NaHCO_3 = 2CaCO_3 + 2NaCl + 2NaOCl + H_2CO_3$. The carbonic acid is sufficient to neutralize the alkali formed in the dissociation of the bleaching powder, as probably in addition to the above equation a certain amount of $Ca(OH)_2$ is formed.

Cost.—It has been found in France that the cost of the solution works out at about three centimes per litre, or that the amount required to treat one average case for twenty-four hours is considerably less than one halfpenny.

Review.

ACUTE APPENDICITIS. By C. Hamilton Whiteford. London: Harrison and Sons, Pall Mall. 1917. Pp. 72.

Mr. Whiteford has written a very interesting and readable little book on acute appendicitis, embodying his experiences connected with it during a period of twenty-five years. The book is well arranged and contains much that is worth remembering and acting upon. The author is not content with recording merely his own observations, but quotes many *obiter dicta* of others, notably, of Moynihan and Murphy. A point particularly interesting is touched on when he comments on certain cases in which soldiers recently inoculated against enteric have abdominal symptoms strongly simulating an attack of acute appendicitis; it is to be hoped he will publish some more notes on this point, and also as to the condition of the small intestine in cases of true appendicitis which have been operated on shortly after antityphoid inoculation.

Mr. Whiteford gives a salutary warning of the dangers into which an over-zealous surgeon may be betrayed by yielding to a desire to accomplish too much at one operation. The book should be digested by all house surgeons and newly-qualified men. G. S. W.

Correspondence.

(1) PRESENCE OF *B. PYOCYANEUS* IN WATER SUPPLIES; (2) TISSUE-PAPER LATRINE RECEPTACLES FOR USE IN THE FIELD.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—The following experience and suggestion may be of interest to your readers, and as regards the first I should very much like to hear of references to current literature, and experiences of other Medical Officers working in tropical climates:—

(1) The experience refers to the presence of *B. pyocyaneus* in drinking water and mineral waters. The circumstances of the case are as follows: A frontier force was camped at the upper reaches of the River Shahur, in Waziristan, which, lower down, takes the name of Zam, and supplies tanks in the Derajat area (N.W.F.P. of India). The river was daily crossed by camel convoys. The same organism was isolated at the same time from dysenteriform stools of soldiers and sepoys evacuated from the Force (six times out of twenty-one examinations).

B. dysenterica Shiga was also isolated from others of the same series, and in one case it was associated with *B. pyocyaneus*.

B. pyocyaneus appeared exclusively when any common sewage organisms had been disposed of by chloride treatment of the water. The raw water contained sewage indicators in 0·1 cubic centimetre.

Is *B. pyocyaneus* a common normal inhabitant of intestines of man, camel, horse and mule? I have isolated *B. pyocyaneus* in pure culture from blood of fever cases in India; some of these were suffering from kala-azar. In other cases, *B. coli communior* was also present.

(2) The *suggestion* refers to the possible use in the field of certain tissue-paper collapsible latrine receptacles, mounted on a wire frame, very much like the Chinese lantern. The paper should be non-porous, and impregnated with paraffin. The capacity and resistance of the article should be such as to be able to receive a semi-liquid evacuation, and be carried without leaking to the adjoining incinerator. The advantages to be claimed for such a novelty are as follows: (1) Considerable less bulk and weight, hence great saving in transport; (2) saving of water and disinfectants, which, as everybody knows, are indispensable concomitants of the latrine pan, hence great saving in sweepers, disinfectants and transport; (3) the article, if practical, is absolutely sanitary; (4) each

soldier will be supplied with a reasonable number daily and trained to its use in the field.

Hoping that my letter will appeal to those of your readers who have had experience of field service on the Indian frontier in the tropical heat of May to August when the fly is ubiquitous,

I am, &c.,

Rawal Pindi Club,
Rawal Pindi.
August 31, 1917.

J. E. H. GATT, *Major, R.A.M.C.,*
Late Sanitary Officer to the
Waziristan Field Force.

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Original Communications.

ON THE BACTERIOLOGY OF WOUND INFECTIONS IN CASES OF TETANUS AND THE IDENTIFICATION OF *BACILLUS TETANI* BY SEROLOGICAL REACTIONS.

BY CAPTAIN W. J. TULLOCH.

Royal Army Medical Corps.

(Lecturer on Bacteriology at the University of St. Andrews.)

From the Laboratories of the Royal Army Medical College and the Lister Institute of Preventive Medicine.

PURPOSE OF THE INQUIRY.

THE bacteriology of tetanus has so far received but little attention, probably because the investigation of the subject is fraught with technical difficulties, and because the physiological or experimental study of the disease is susceptible of examination with greater facility, and offers more dramatic and obvious results than those likely to be obtained from bacteriological inquiry. It appeared, therefore, necessary to prosecute a bacteriological research into the characters of the causal organism of tetanus, for the following reason.

It has been the experience of history in bacteriology that clinical conditions which were at one time thought to be due to infection with a single variety of one bacterial species, have been shown, on further examination, to be produced by a number of micro-organisms. Bacillary dysentery, typhoid and paratyphoid fevers, Malta fever, infection with streptococci and pneumococci, and cerebrospinal fever have all had such a history.

At one time each of these conditions was thought to be due to infection by a single specific micro-organism, but now we recognize a group of dysentery bacilli differing one from another; typhoid is differentiated from paratyphoid, and paratyphoid A from paratyphoid B. Infection with *Micrococcus melitensis* is recognized as a separate condition from infection with *M. paramelitensis*. The vaccine therapist has been forced by circumstances to recognize a number of varieties of streptococci, and recently we have had evidence of the importance to therapeutics of the differentiation of pneumococci and meningococci into serological races.

In view of the difficulty experienced in isolating *Bacillus tetani*, it appeared not improbable that this aspect of the question had been overlooked, and that owing to our accepting the clinical entity, tetanus, as being caused by a single variety of one organismal species, an important factor in the pathology of the disease remained uninvestigated, to the possible detriment of prophylaxis and therapeutics.

This concept is of extreme importance, in that if the thesis that there is more than one antigenic variety of *B. tetani* be proven, both the serum prophylaxis and the serum therapeutics of the disease can in all probability be improved, and an answer might even be found to the question: "Why is it, that although remarkable results have been achieved by the prophylactic use of tetanus antitoxin, the employment of the serum in this way has failed to eliminate the disease in case of the wounded?"

The purpose of the present inquiry then, is to determine whether *B. tetani* may be regarded as an individual organism, or whether there is a group of tetanus bacilli, any of which may give rise to a spasm-producing substance, toxic for man and animals.

While this main purpose was kept in view, a number of subsidiary problems were not lost sight of, and an attempt is made to answer, to some extent at least, the following questions:—

(*a*) Are there frequently present in wound exudates, and notably in wound exudates from cases of tetanus, any organisms that have morphological characters so like those of *B. tetani*, that in film preparations from wounds or cultures they are liable to be mistaken for that organism?

(*b*) What influence, if any, do these, and other organisms frequently present in wounds, have upon the development of *B. tetani* or the elaboration of its toxin?

(*c*) What is the significance of *B. sporogenes* (*B. œdematis maligni*), which is almost constantly found in exudates from wounds infected with *B. tetani*?

This paper is divided into two sections :—

(1) Dealing with the preliminary investigations designed to elaborate a method for the isolation and examination of *B. tetani*.

(2) Dealing with the serological classification of the spasm-producing organisms.

PART I.

Preliminary Investigations.

The principal and the initial obstacle to be overcome in the study of *B. tetani* is that the methods hitherto employed for isolating it have proved inadequate for dealing with numbers of strains of the organism.

If material from wounds infected with *B. tetani* be spread on the surface of a solid medium, it is only very occasionally that colonies of that organism develop satisfactorily. The majority of the anaerobes are motile, and if the medium be slightly moist, the growing colonies spread out and coalesce, so that isolation is impossible. On the other hand, if the medium be sufficiently dry to prevent this coalescing of the colonies, the inhibition of growth, and particularly of growth of *B. tetani*, is so marked that the organism may fail to develop at all.

A similar difficulty is met with when deep tubes of a solid medium are used, as in the method of Veillon and Zuber (*Arch. de Med. Exper. et d'Anat Path.*, 1898, X), for gas-producing organisms are almost invariably present in the inoculum, and the splitting of the medium with the growth of the organisms on the split surfaces results only in further contamination.

The ideal medium for the isolation of *B. tetani* would be a fluid medium which favoured the growth of that organism, and restrained completely the growth of the other anaerobic bacteria commonly found in wounds along with it. Such a culture medium would have the advantage of being a fluid so permitting of a luxuriant growth being obtained, while at the same time it would assist greatly in the preliminary stages of the isolation of the organism by any physical method of separation that one might subsequently choose to adopt.

A medium that provides enrichment of *B. tetani* in cultures made from inocula containing a variety of organisms, has been prepared by me with a fair amount of success.

The stages of the investigation that led to the preparation

of this medium are of considerable interest and import, in that they call attention to symbiosis as a factor in the pathology of infections with the anaerobic bacteria. The elaboration of the method answers also, partially at least, certain of the subsidiary questions that are noted in the final paragraph of the introduction to this communication.

(A) *Culture Cycle through which Tubes of Meat Medium, inoculated with Material from Wounds, are passed.*

The observation upon which is based the preparation of a selective culture medium, arose out of the daily microscopical examination of cultures of material from tetanus-infected wounds, grown in chopped meat water medium, and incubated anaerobically at 37° C.

The material for examination is dealt with thus: A swab or specimen of pus from the wound is emulsified in saline, heated to 60° C. for forty-five minutes, or to 80° C. for fifteen minutes, in order to kill the non-sporing organisms which are present. The heated emulsion is then used for inoculating the meat tube.

When this procedure is made use of, the field of investigation is limited to the spore-bearing anaerobes, and for purposes of rough classification we may divide these into three groups according to their morphological characters.

(*a*) Organisms developing a spore situated centrally or sub-terminally, the spore being ellipitical in shape. These I shall refer to as the sporogenes morphological type.

(*b*) Organisms bearing a spherical terminal spore—the tetanoid bacilli.

(*c*) Organisms which develop an oval spore situated terminally. I shall refer to these simply as oval end-sporing bacilli, as there appear to be a considerable number of organisms in this group, and their differentiation from one another by serological and cultural methods is still proceeding.

Material from wounds in cases of tetanus nearly always contains representatives of all three groups, and a meat tube inoculated therewith passes through a more or less definite cycle. This cycle is demonstrated in the following table, which epitomizes the findings obtained on making daily microscopical examination of meat water tubes, each inoculated with a specimen of pus from the wound exudate in two cases of tetanus.

TABLE I.

Day of culture	Inoculum No. T 3			Inoculum No. T 32		
	Tetanus type	Sporogenes type	Oval end-spore bacilli	Tetanus type	Sporogenes type	Oval end-spore bacilli
1	–	–	–	–	+	–
2	–	+	–	–	++	–
3	–	++	–	–	++	–
4	–	++	–	–	++	?
5	+	++	?	?	++	+
6	++	+	+	+	+	++
7	++	+	+	+	+	++
8	++	(+)	+	++	(+)	++
9	++	(+)	++	++	(+)	+
10	+	(+)	++	++	(+)	+

++ = Predominant organism.
+ = Present in considerable numbers.
(+) = Spores only.
? = End-sporing bacilli, but spores too young to permit of opinion being offered as to whether spores are round or oval.

The subsequent history of these cultures is interesting. From T 3 a toxic tetanus bacillus, belonging to the same serological group of *B. tetani* as does the standard U.S.A. culture, was obtained. Culture T 32, on the contrary, failed to give toxin, and also failed to agglutinate in presence of any of the sera corresponding to the three types of toxin-producing organisms so far obtained. The cultural cycle shown in Table I is so frequently seen that one cannot but be impressed with its probable import.

The *B. sporogenes* is a powerful protein digester, and being a vigorous organism it is usually the first to appear in the culture. [The preliminary heating of the inocula to 80° C. kills off *B. Welchii* (perfringens) in the majority of cases.] The growth of *B. sporogenes* causes digestion of the meat, and gives rise to protein break-down products, which constitute a suitable pabulum for the tetanoid and oval end-sporing bacilli.

This is further evidenced by the fact that while pure cultures of *B. tetani* not infrequently fail to grow, or "sulk" when subcultured, these same bacilli will grow vigorously if even ever so slight a contamination of the tubes with *B. sporogenes* should occur. The chemical basis of this symbiosis I have not investigated, as it did not appear to me to be of immediate practical import.

(B) *Preparation of a Selective Medium.*

(1) *Exhausting the Medium by cultivating B. sporogenes and oval end-sporing Bacilli therein.*—I was so deeply impressed with the constancy of the cultural cycle indicated in the previous

section that I decided to make use of it for the preparation of a selective medium. The method is as follows: A large flask of cooked meat water is inoculated with a culture of *B. sporogenes*, and is incubated for five days at 37° C. By this time, if a vigorous culture of sporogenes is used for seeding the flask, the meat is to a large extent digested. The fluid derived from this consists of a solution of the products of the digested meat; it is filtered first through paper, and then through Berkefeld and Doulton bougies in series, in order to effect sterilization. This fluid is stored in a filter flask under paraffin, and has added to it sufficient sodium formate to make the total concentration of that reagent equal to 1 per cent. The material is delivered into tubes when required, all precautions being taken to ensure the procedure being carried out under strictly aseptic conditions.

Material from wounds, known by culture in the cooked meat medium to contain organisms both of the sporogenes type and of one or both of the other types, was inoculated into this medium, and the resulting cultures consisted only of tetanoid bacilli, and oval end-sporing organisms. This medium was to a large extent a failure, in that the oval end-sporing bacilli were almost always predominant in cultures grown in it.

An attempt was therefore made to exhaust the nutritive properties of the medium in respect of both the sporogenes type of bacilli and the oval end-sporing organisms. The flask of meat was inoculated with both sporogenes and oval end-sporers, either together or in sequence, and the flasks were incubated from ten to thirty days before their contents were filtered.

Media so prepared were either exhausted so completely that they were quite inadequate as cultural material, and failed to sustain growth, or were insufficiently exhausted and permitted of the development of a strong growth of oval end-sporing bacilli. In no case did I succeed by this method in preparing a medium, which, while restraining sporogenes, at the same time stimulated the tetanoid organisms at the expense of the oval end-sporers.

This is quite explicable in the light of further work that is at present being done on the serological differentiation of these oval-spored bacilli. This serological work shows that there are a number of varieties of anaerobic bacilli that develop oval spores, terminal in situation. As I was forced to employ pure cultures for purposes of exhaustion, and as I had failed to appreciate the multiplicity of organisms of this type, I naturally failed to exhaust completely the nutritive properties of the meat in respect of these oval end-sporing bacilli.

It should be noted that in my hands when any attempt was made to sterilize these media by heat, they lost to a large extent their selective properties.

(C) *Medium prepared by Exhaustion brought about by Natural Putrefaction.*

Failing in the attempts to produce a selective medium through the employment of a "controlled putrefaction," I decided to allow the meat to undergo natural putrefaction, hastening the initial stages of the process by digestion with trypsin, and to employ the filtered products of the putrefaction as a culture medium.

Method.—One pound of ox-heart is boiled for half an hour in a litre of tap water, the fluid is then made slightly alkaline to litmus, and trypsin is added when the fluid has cooled. The process so far exactly follows the directions for the preparation of Douglas' trypsin broth, but after the addition of the trypsin, the mixture, in an open vessel, is allowed to incubate for five days at 37° C.

The putrefying material has a foul odour, and microscopical examination shows the presence of a great variety of bacteria in the fluid. This flora contains vast numbers of organisms of the sporogenes type, and of the oval end-spore-bearing type.

The fluid products of putrefaction are dealt with in exactly the same way as was the fluid obtained by "exhaustion" with *B. sporogenes*.

Medium prepared in this way has marked selective properties, and, if stored in the manner described in the previous section, it retains these for a considerable time. I have used it with success at least two months after its preparation.

Media prepared in this way appear to be over-exhausted, and are deficient in nutrient qualities. It was therefore found necessary to add some growth-stimulating material to the medium before using it.

A number of such "enriching" or growth-stimulating substances were tried. In general terms the results obtained were as follows:—

(1) Vegetable extracts—extract of pea, of potato, of beans and of yeast—stimulated the reproduction of the oval end-sporing bacilli at the expense of the tetanoids.

(2) Fresh human blood, if added in large enough quantity to give a growth sufficiently luxuriant to permit of its being further investigated, caused the organisms of the sporogenes type to reappear.

(3) The most satisfactory results were obtained when fresh sterile rabbit kidney was the enriching material employed.

I find that the addition of, roughly, one-eighth part of a kidney to a tube containing ten cubic centimetres of the medium permits of the development of a heavy growth, and is found, if not to stimulate the growth of the tetanoids at the expense of the oval end-sporing bacilli, at least to allow of the growth of both these groups equally well.

The employment of the rabbit kidney for this purpose has the additional advantage that incubation can be carried out aerobically after the manner described by Tarozzi (*Cent. f. Bact.*, Orig., 1905, Bd. xxxviii.).

The following table illustrates the microscopical characters of cultures from wound exudates, seeded directly into this medium after preliminary heating to 80° C. for fifteen minutes. Cultures of the same inocula grown in meat medium are shown for comparison.

TABLE II.

Day of culture	Inoculum	No. T 67
	Growth in cooked meat water	Growth in selective medium
1	No growth	No growth
2	,, ...	,,
3	Sporogenes, sporing well	Few non-sporing bacilli
4	,, ,, ...	End-sporing bacilli (? round or oval spore)
5	Sporogenes and non-sporing bacilli..	Entirely spherical end-spores
	Inoculum	**No. T 77**
1	Non-sporing bacilli	No growth
2	Sporogenes and non-sporing bacilli ..	,,
3	,, ,, ,, ..	Non-sporing bacilli
4	Sporogenes and (?) round (?) oval end-spores	End-sporing bacilli (? round or oval spores)
5	,, ,, ,,	Entirely spherical end-spores

The subsequent history of these cultures is interesting. It will be seen from Part II that T 67 was a toxic bacillus and T 77 was non-toxic (*vide* Table XIII).

From a number of batches of medium prepared in this way, specimens were taken for rough titration before filtration. Phenolphthalein was used as the indicator in these titrations. It was found that those batches which were nearly neutral to that reagent

exhibited more selective properties than did those which were less alkaline in reaction.

The medium which I found most satisfactory, and which I am at present employing, is prepared thus:—

Take one pound of chopped meat, add one litre of water, boil for thirty minutes, cool to 45° C., and adjust the reaction of the fluid so that it is slightly alkaline to litmus. Trypsinize as for the preparation of Douglas' broth, and incubate in an open vessel for five days at 37° C. Filter the products of putrefaction through paper, add sodium formate to the extent of one per cent of the total, and adjust the reaction of the fluid to the neutral point for phenolphthalein. The fluid is then filtered through a Berkefeld and a Doulton filter in series, and is stored under paraffin in a sterile flask, mounted with a hooded delivery pipette so that the medium may be distributed into tubes.

Before use, each tube of ten cubic centimetres is enriched by the addition of one-eighth part of fresh rabbit kidney, which has been removed (after killing the animal) by a sterile operation. I usually employ tubes containing five cubic centimetres of the medium and add one-sixteenth part of kidney to each.

The removal of the kidney is easily performed as an aseptic operation, and the number of tubes that are contaminated is remarkably small after a certain degree of dexterity has been attained.

Before making use of the filtrate from the putrefied meat, one should be assured of its sterility. This is done by inoculating 5 cubic centimetres, 1 cubic centimetre, 0·5 cubic centimetre, 0·1 cubic centimetre, and 0·01 cubic centimetre into meat tubes which are incubated anaerobically for fourteen days, and should show no evidence of growth.

It will be seen from Section D, Part II, of this communication that cultures grown directly from wounds, in the putrefied medium can be satisfactorily examined by the agglutination test.

One great advantage of the selective medium is, that when grown in it, *B. tetani* sporulates very readily, so that characteristic morphological types are obtained. This aids greatly in the isolation of the organism by Barber's single bacillus or micro-inoculation method (Barber, *Philippine Journ. of Science*, Medical Section B, August, 1914, vol. ii, p. 307), and the cultures which were subsequently employed for inoculating rabbits in order to prepare specific agglutinating sera, were isolated by that technique.

I wish here to offer my thanks in a very special manner to Miss Robertson, of the Lister Institute, who isolated for me by means

of Barber's method a number of cultures of round and oval end-sporing bacilli, obtained from wounds, and which, while they had been enriched in my laboratory, by culture in the selective medium, were not sufficiently pure growths to justify my using them for the purpose of immunizing animals.

This work is extremely arduous, and without Miss Robertson's kindly offer of help, my investigation of the tetanus bacillus by serological methods would have been considerably delayed.

(*D*) *Attempts to render more Selective the Medium described above.*

All that can be claimed for the medium described in the previous section is that it markedly inhibits the growth of *B. sporogenes*, and allows of the equal development of *B. tetani*, the tetanoid bacilli, and the oval end-sporers. I therefore decided to attempt to make the fluid still more selective by adding to it reagents which might differentiate between the round and oval end-sporers.

A number of aniline dyes—e.g., malachite green, brilliant green, methyl violet, crystal violet and also phenol—were experimented with in a variety of dilutions. None of these exhibited any desirable selective properties, except crystal violet and brilliant green, which, used in a dilution of 1/2500 to 1/3000, restrained to some extent the growth of oval end-sporing bacilli. These dyes were used in tubes enriched by the addition of fresh tissue, and it is to be noted that in the absence of such enrichment a very much lower concentration of these dyes than that indicated suffices to inhibit the growth of the anaerobic organisms.

This point is of some import at present, in view of the recent employment of these and similar reagents in surgical practice.

For some time I made use of crystal violet in a dilution of 1/3000 but found that its action was capricious, and really unsatisfactory, as the range of dilutions in which it served to differentiate the growths was extremely limited, particularly when the medium was sufficiently alkaline to inhibit the growth of the *B. sporogenes*.

The following table illustrates the results obtained in one of the more successful experiments of this series. The cultures which were used were :—

(*a*) Tetanus, U.S.A. standard culture.

(*b*) *B. sporogenes* isolated by Miss Robertson from a stock culture obtained from Dr. O'Brien, the Wellcome Research Laboratories.

(*c*) A slender non-toxic bacillus, bearing an almost spherical terminal spore, and isolated by Miss Robertson from a culture of wound exudate grown in the selective medium.

TABLE III.

	Selective medium: putrefaction for five days. Neutral to phenolphthalein			Ordinary peptone broth. Neutral to α naphtholphthalein		
	T (U.S.A.)	Sporogenes	T 68	T (U.S.A.)	Sporogenes	T 68
			Twenty-four hours			
No dye added ..	Fair growth, filamentous	? Few bacilli	Good growth of bacilli and filaments	Good growth, bacillary	Strong growth, sporing	Fair growth, filamentous
+ brilliant green, $\frac{1}{3000}$	Slight growth, filamentous	No growth ..	No growth ..	Fair growth, filamentous	Good growth, not sporing	No growth
+ crystal violet, $\frac{1}{3000}$	Slight growth, filamentous	No growth ..	No growth ..	Slight growth, filamentous	Good growth, not sporing	No growth
			Forty-eight hours			
No dye added ..	Good growth, few sporing	No growth ..	Good growth, fair number sporing	Strong growth, fair number sporing	All sporing ..	Strong growth, not sporing, filamentous
+ brilliant green, $\frac{1}{3000}$	Fair growth, not sporing, filamentous	No growth ..	Few non-sporing bacilli	Filamentous growth, not sporing	Very many sporing	No growth
+ crystal violet, $\frac{1}{3000}$	Fair growth, not sporing, filamentous	No growth ..	Few non-sporing bacilli	Non-sporing growth, filamentous	Few sporing ..	No growth
			Four days			
No dye added ..	Good growth, few sporing	No growth ..	Nearly all are sporing	Fair number sporing	All sporing ..	Strong growth, not sporing, filamentous
+ brilliant green, $\frac{1}{3000}$	Filamentous, non-sporing	No growth ..	Slight growth, few sporing	Few sporing, filamentous	Many sporing ..	No growth
+ crystal violet, $\frac{1}{3000}$	Filamentous, non-sporing	No growth ..	Slight growth, non-sporing	Non-sporing growth, filamentous	Many sporing ..	No growth

Note 1.—Each tube was enriched by addition of rabbit tissue, and incubation was carried out aerobically.
Note 2.—When the ordinary broth is neutral to phenolphthalein, the inhibition of the non-toxic bacilli is not so marked.

This encouraging result could not, however, be reproduced constantly, apparently because there are several varieties of tetanoid and oval end-sporing bacilli, which may be present in wound exudates, and a reagent that will inhibit the growth of one of these will not inhibit the growth of all.

When this work on the use of aniline dyes as adjuvants to the selective medium was being carried out, I was not sufficiently appreciative of the variety of organisms whose growth I was attempting to restrain. In view of the results now obtained by serological differentiation of the tetanoid and oval end-sporing bacilli, I propose to review this aspect of the work, for there are apparently two serological types of non-toxic end-sporers that are of specially frequent occurrence in wound exudates from cases of tetanus. One of these is considerably restrained in its growth by the presence of 0·01 per cent thallium acetate, or 0·1 per cent beryllium nitrate. The employment of these and kindred reagents was suggested to me by Dr. C. H. Browning, Director of the Bland-Sutton Institute of Experimental Medicine, and I am deeply indebted to him, both for his suggestion and for his kindness in supplying me with solutions of salts of the rare earths, so that I might test their value for the purpose in view.

The practical application of these salts to the isolation of *B. tetani* is still under examination.

(E) *Inquiry into the Factors which determine the Selective Properties of the Putrefied Medium.*

It appeared of some import to examine the conditions which determined the selective character of the medium, as an inquiry with this object in view might aid in the elucidation of certain of the subsidiary problems that arise in connexion with the bacteriology of wound infections due to the anaerobes.

Sections A, B and C of this paper all suggest that there may be a symbiotic factor at work in anaerobic infections, and I therefore made a simple general inquiry into the nature and mechanism of this apparent symbiosis.

The following experiment which is one of a series that all corroborate one another is of some interest.

Three portions of chopped meat, each consisting of four ounces, were boiled each with 250 cubic centimetres of water. They were all rendered equally alkaline by the addition of a measured quantity of NaOH solution and to each was added the same quantity of trypsin.

Portion one was allowed to digest for three hours at 37° C. and was then dealt with as for the preparation of Douglas' trypsinized broth.

Portion two was allowed to putrefy for twenty-four hours. It was then made neutral to α-naphtholphthalein, was autoclaved, and put into the ice-chest to sediment, after which the clear supernatant fluid was pipetted off.

Portion three was allowed to putrefy for forty-eight hours and was then dealt with in the same way as portion two.

Each portion was then divided into four equal parts—1a, 1b, 1c, and 1d, 2a, 2b, etc.

Broths 1a, 2a, and 3a, were now titrated by Sorensen's method to have a hydrogen ion concentration of PH 8.

1b, 2b, and 3b	to have a concentration equal to	PH 9.
1c, 2c, and 3c	,, ,, ,,	PH 10.
1d, 2d, and 3d	,, ,, ,,	PH 11.

All twelve flasks were then boiled for five minutes, the contents filtered through sterile paper, and the filtrate distributed into sterile tubes.

The filled tubes were finally sterilized in the autoclave at 120° C. for ten minutes.

A tube of each series was then inoculated with the following cultures:—

(1) *B. tetani* U.S.A. standard culture.

(2) *B. sporogenes.*

(3) A non-toxic end-sporing bacillus—T 68.

And incubated anaerobically at 37° C. in a "Martin's jar." Examined after four days the result shown in Table IV was obtained.

Note.—While in Table IV the hydrogen ion concentration is expressed as PH 8, 9, 10, and 11, one recognizes that such is false owing to the heating, filtration, etc., to which the material was subjected after titration.

The result is interesting and indicates that the thesis advanced in the previous sections is probably correct. The degree of putrefaction and the increase in alkalinity have a marked influence upon the nutritive and selective properties of the medium.

B. sporogenes gives rise to protein breakdown products that are suitable for the growth of the end-sporing bacilli, including *B. tetani*, while a further stage of putrefaction results in a medium that is especially suitable for the development of the non-pathogenic end-sporing bacilli.

This observation is of some practical import in that the presence of numbers of non-toxic end-sporing bacilli in cultures made from wound exudates, indicates that the wound is in a condition suitable for the development of *B. tetani.*

TABLE IV.

Reaction	Medium : three hours' digestion		
	Tetani	Sporogenes	T 68
PH 8 ..	Strong growth, few sporing	All sporing, strong growth	Non-sporing bacilli
PH 9 ..	Strong growth, not sporing	Strong growth, many sporing	Non-sporing bacilli
PH 10 ..	No growth	Strong growth, not sporing	Non-sporing bacilli
PH 11 ..	No growth	No growth	No growth
Reaction	**Medium : twenty-four hours' putrefaction**		
	Tetani	**Sporogenes**	**T 68**
PH 8 ..	Strong growth, few sporing	Strong growth, many sporing	Non-sporing bacilli
PH 9 ..	Fair growth, filamentous, non-sporing	NO GROWTH	Non-sporing bacilli
PH 10 ..	No growth	No growth	No growth
PH 11 ..	No growth	No growth	No growth
Reaction	**Medium : forty-eight hours' putrefaction**		
	Tetani	**Sporogenes**	**T 68**
PH 8 ..	No growth	No growth	End-sporing bacilli
PH 9 ..	No growth	No growth	End-sporing bacilli
PH 10 ..	No growth	No growth	No growth
PH 11 ..	No growth	No growth	No growth

Examination after four days' incubation, anaerobically; no enrichment.
Note.—Toxic culture T 67, which was included in the above experiment, behaved exactly as did T 68.

This is very strikingly shown by the fact that in over ninety per cent of the cultures which I have examined in cases of tetanus, tetanoid end-sporers have developed in large numbers. Only a relatively small number of the cultures are, however, toxic (*vide* Part II, Section D, Table XIII). On the other hand, Miss

Robertson has shown that in the case of wound exudates from men showing no evidence of tetanus such bacilli are found in only twenty-five per cent of the cases.

(*F*) *Note concerning the Purity of Cultures and the Function which the Selective Medium is designed to subserve.*

Before proceeding to a consideration of the results obtained by investigating certain of the anaerobes by serological methods, I wish particularly to call attention to the fact that the medium described herein does not give pure cultures of the end-sporing bacilli. It merely gives overwhelming growths of these organisms, and restrains very largely the development of organisms belonging to the sporogenes group.

If *B. tetani* be present in considerable numbers in the material inoculated, that organism will grow sufficiently well in the medium to permit of the culture so obtained being examined by the agglutination reaction. It is cultures of this degree of "purity" that are considered in Section D, Part II, Table XIII.

The cultures obtained from various serum institutes are very much purer than those obtained by primary culture in the selective medium, but even these are found to be contaminated not infrequently. Admittedly the contamination is in most cases negligible, but in one culture that I have examined the contaminating organism —an end-sporing bacillus whose spore is almost spherical—was present in very large numbers.

I lay stress on this point concerning the purity of cultures of the anaerobes, as one hesitates to employ the term "pure" to any growth of these. For this reason, too, one cannot state what are the cultural characters of *B. tetani* which are even now imperfectly defined. In one case, that of an isolation from the standard U.S.A. culture made by Miss Robertson employing the Barber technique, a culturally definite strain of *B. tetani* has been obtained.

It was, therefore, futile for me to attempt to investigate *B. tetani* by means of the growth reactions, and of set purpose I refrain from any attempt to describe its cultural characters.

In addition to isolating the definitely pure cultures from the U.S.A. standard growth, which has served as a starting point for the serological investigation of the problem under consideration, Miss Robertson very kindly isolated from my cultures in a fair state of purity a number of toxic and non-toxic strains.

The toxic growths among these compare not unfavourably, from the standpoint of purity, with the strains in use in the various serum institutes for the production of tetanus antitoxin.

These toxic growths obtained from wounds, and so purified, are of paramount import in that they formed the basis upon which could be constructed a schema for the serological investigation of *B. tetani*.

In conclusion, I should warn all who may be engaged on a study of the anaerobic bacteria, when describing cultures of these, to employ the term "pure" with the utmost caution, for the majority of cultures of anaerobic bacteria are only relatively pure, probably because their isolation is difficult owing to their strong symbiotic relationship to one another.

PART II.

Serological Investigation of a Number of Strains of *B. tetani* isolated by the above Method.

(*A*) *Investigation of Relatively Pure Cultures.*

In the first series of experiments in which serological methods were employed I decided to confine my attention to:—

(1) A number of laboratory strains of *B. tetani*, known to be relatively pure, obtained from serum institutes.

(2) The small number of relatively pure toxic growths isolated from wound material.

Technique.—(1) *Cultivation of Organism and Preparation of Emulsion.*—The culture selected for the immunization of the first animal was the purest growth to which I had access—the isolation (No. 2) made by Miss Robertson from the standard U.S.A. strain.

The organism was grown in ordinary peptone broth neutral to a-naphtholphthalein under anaerobic conditions for four days. The broth culture was then centrifuged at high speed and the fluid was carefully pipetted off from the resulting deposit.

A film was made from the deposit and examined microscopically in order to exclude the possibility of gross contamination having occurred, the deposit was then suspended in saline (0·75 per cent), standardized by the opacity method to contain 2,000 million bacilli per cubic centimetre and thereafter heated to 65° C. for thirty minutes.

This heating of the suspension serves to reduce to some extent its toxicity and at the same time limits the power of any autolysin that may be present. After heating to 65° C., a five per cent solution of phenol is added to the extent of one-tenth of the total, so that the organisms are actually preserved in 0·5 per cent phenol saline. The heating of the suspension and the addition of phenol are essential if the emulsion is to be stored.

I find that suspensions so prepared are quite constant in their behaviour up to periods of at least three months.

(2) *Immunization of Animal.*—The animals chosen for the production of agglutinating serum were rabbits, and each animal was tested to see that it did not possess natural agglutinins to any of the common anaerobes before the process of immunization was begun.

The method of immunization used was that described by Hine (JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, October and December, 1915). The animals were bled out on the serum attaining a titre of 1/800 when tested for two hours at 55° C. The tests have all been carried out at this temperature and the readings made at two hours in all cases.

I may here note that out of six animals each of which was inoculated with an emulsion of a definitely toxic culture, prepared as indicated above, only two developed symptoms of tetanus.

This technique for the preparation of the emulsion and the immunization of the animals was used in the case of both toxic and non-toxic bacilli for some time, but later I found I could add rabbit kidney to the medium and so obtain more luxuriant growths without in any way altering the reaction, the results, when this was done, being quite comparable with those obtained when the original technique was used.

When this is done it is essential only to employ tissue derived from the same species of animal as that which is being immunized.

(B) *Results obtained.*

(1) *Technique of Agglutination Reaction.*—A standard technique is employed: The serum is diluted to 1/50, 1/100, and 1/200. These dilutions of serum are distributed into tubes three inches by three-eighth inch, 0·5 cubic centimetre per tube, and to each concentration of each serum is added 0·5 cubic centimetre of a 2,000 million emulsion of the organism to be investigated. One is then agglutinating 1,000 million bacilli in a unit volume of one cubic centimetre in presence of 1/100, 1/200, and 1/400 dilutions of

the sera. The reaction is carried out at a temperature of 55° C. and the results read off after two hours.

(2) *Agglutination of Cultures by Serum of Animal immunized with Tetanus U.S.A. Culture, Isolation II* (*Robertson*).—Using the standard technique the following results were obtained with this serum :—

TABLE V.

Register number of culture	Whence derived	"U.S.A. agglutinating serum"			Normal serum
		$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$	$\frac{1}{50}$
U.S.A. II ..	Isolation from U.S.A. standard culture	++	++	++	–
U.S.A. I	,, ,, ,, ,, ,,	++	++	++	–
U.S.A. whole ..	U.S.A. standard culture	++	++	++	–
Tet M	Serum Institute X	++	++	++	–
Tet M B 4 ..	,, ,, ...	+	+	+	–
Tet Kolle.. ..	Indirectly from Berne	++	++	++	–
Tet Q	Serum Institute Y	++	++	++	–
Tet O B 8 ..	,, ,, ...	++	++	++	–
T 3 iv, D 3 ..	Isolated from wound	++	++	++	–
T 67, R viii ..	,, ,, ,, ...	–	–	–	–
T 72, B R A ..	,, ,, ,, ...	–	–	–	–
T 79 iv	,, ,, ,, ...	–	–	–	–
T 80 B i	,, ,, ,, ...	–	–	–	–
R 220 Sp.. ..	,, ,, ,, ...	–	–	–	–
Control	Culture used for immunization ..	++	++	++	–

In this and subsequent tables :—

++ = complete flocculation, supernatant fluid clear.
+ = marked flocculation but supernatant fluid not quite clear.
(+) = flocculation but supernatant fluid turbid.

In the above results the following points call for comment :—

(*a*) All the strains of *B. tetani* obtained from serum institutes, and therefore presumably used for the preparation of antitoxin, react with a serum specific to the standard U.S.A. bacillus. Although a point of minor import, it is to be noted that the two isolations from the U.S.A. culture, and the whole U.S.A. culture, behave in the same way.

(*b*) Only one culture, T 3, obtained from a wound exudate reacts with this serum.

(*c*) Five cultures, though of proved toxicity and of relative purity, fail to react with this serum.

It might be that these five cultures, although toxic, contained such an overwhelming number of some contaminating organism that they failed to show agglutination, because the flocculation was masked by the excess of the contaminator.

The character of the cultures did not indicate that this was probable, but in order to exclude the possibility I prepared agglutinating serums for :—

(i) *B. pseudotetani*, a non-toxic bacillus, closely resembling *B. tetani*, both in morphological characters and in cultural reactions. (*B. pseudotetanus* corresponds to the organism which Dr. McIntosh describes under this title.)

(ii) Two strains of *B. sporogenes* from wounds.

(iii) An end-sporing bacillus, apparently in pure culture, but differing from *B. pseudotetani* and also apparently from *B. hibler* IX. This organism is very frequently present in wound exudates from cases of tetanus.

With these sera the following results were obtained :—

TABLE VI.

	Sporogenes Agglutinating serum			Pseudotetani Agglutinating serum			R 27 C D 5 Agglutinating serum			Normal serum
	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$	$\frac{1}{50}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{50}$
U.S.A. II ..	—	—	—	—	—	—	—	—	—	—
U.S.A. I ..	—	—	—	—	—	—	—	—	—	—
U.S.A. (Whole)	—	—	—	—	—	—	—	—	—	—
Tet M	—	—	—	—	—	—	—	—	—	—
Tet M B 4 ..	—	—	—	—	—	—	++	++	+	—
Tet Kolle ..	—	—	—	—	—	—	—	—	—	—
Tet Q	—	—	—	—	—	—	—	—	—	—
Tet 0 B 8 ..	—	—	—	—	—	—	—	—	—	—
T 3 iv D 3 ..	—	—	—	—	—	—	—	—	—	—
T 67 R viii ..	—	—	—	—	—	—	—	—	—	—
T 72 B R A ..	—	—	—	—	—	—	—	—	—	—
T 79 iv.. ..	—	—	—	—	—	—	—	—	—	—
T 80 B i ..	—	—	—	—	—	—	—	—	—	—
R 220 Sp ..	—	—	—	—	—	—	—	—	—	—
Sporogenes ..	++	++	++	—	—	—	—	—	—	—
Pseudotetani ..	—	—	—	++	++	++	—	—	—	—
R 27 C D 5 ..	—	—	—	—	—	—	++	++	++	—

This result shows that the negative agglutination results in presence of "U.S.A. agglutinating serum," in the case of the five toxic cultures, were *not* due to the presence of contaminating organisms. Culture M B 4 is clearly a mixed growth of a tetanus strain corresponding to the U.S.A. culture and a bacillus similar to the organism designated "R 27 CD 5."

(3) *Agglutination of Cultures with Serum of Animal immunized against Culture T* 67, *Isolation Robertson viii.*—In order further to investigate these toxic cultures derived from wound exudates

an animal was immunized against culture T 67 R viii. On testing the same series of cultures with this second serum the following result was obtained :—

TABLE VII.

Register number of culture	Whence derrived	"T 67 agglutinating serum"			Normal serum
		1/100	1/200	1/400	1/50
U.S.A. II ..	Isolation from U.S.A. standard culture	–	–	–	–
U.S.A. I ..	,, ,, ,, ,,	–	–	–	–
U.S.A. Whole ..	U.S.A. standard culture	–	–	–	–
Tet M ..	Serum Institute X	–	–	–	–
Tet M B 4 ..	,, ,, ...	–	–	–	–
Tet Kolle ..	Indirectly from Berne	–	–	–	–
Tet Q.. ..	Serum Institute Y	–	–	–	–
Tet 0 B 8 ..	,, ,, ...	–	–	–	–
T 3 iv D 3 ..	Isolated from wound	–	–	–	–
T 67 R viii ..	,, ,, ,, ...	++	++	++	–
T 72 B R A ..	,, ,, ,, ...	–	–	–	–
T 79 iv ..	,, ,, ,, ...	++	++	++	–
T 80 B i ..	,, ,, ,, ...	++	+	–	–
R 220 Sp ..	,, ,, ,, ...	–	–	–	–
Control ..	Culture used for immunization ..	++	++	++	–

The following points are worthy of note in the above results:—

(*a*) Three toxic cultures T 67, T 79, and T 80 all agglutinated with this serum.

(*b*) The agglutination of T 80 is less marked than in the case of T 67 and T 79. It might either be a mixed culture containing a large number of contaminators, or merely a strain that does not agglutinate readily.

(*c*) There remain cultures T 72 and R 220 that have failed to agglutinate with either the serum specific to the U.S.A. culture, or that specific to the T 67 culture.

These three cultures, then, either represented an antigenic variety of *B. tetani* differing from the U.S.A. standard culture, or they harboured a common contaminator. Further investigation alone would show which of these hypotheses was correct.

(4) *Agglutination of Cultures by Serum of Animal immunized against Culture R* 220.—Strains T 72 and R 220 either represented a third serological variety of *B. tetani*, or were heavily contaminated. An animal was therefore immunized against strain R 220, and the following results were obtained when the same series of suspensions were exposed to the action of this serum.

TABLE VIII.

Register number of culture	Whence derived	R 220 agglutinating serum			Normal serum
		1/100	1/150	1/200	1/50
U.S.A. II ..	Isolation from U.S.A. standard culture	–	–	–	–
U.S.A. I ..	" " " " "	–	–	–	–
U.S.A. Whole ..	U.S.A. standard culture	–	–	–	–
Tet M	Serum Institute X	–	–	–	–
Tet M B 4 ..	" " "	–	–	–	–
Tet Kolle ..	Indirectly from Berne	–	–	–	–
Tet Q	Serum Institute Y	–	–	–	–
Tet O, B 8 ..	" " "	–	–	–	–
T 3 iv, D 3 ..	Isolated from wound	–	–	–	–
T 67, R viii ..	" " "	–	–	–	–
T 72, B R A ..	" " "	++	++	++	–
T 79 iv	" " "	–	–	–	–
T 80, B i ..	" " "	–	–	–	–
R 220, Sp ..	" " "	++	++	++	–
Control	Culture used for immunization ..	++	++	++	–

The same hypotheses might be advanced in respect of these findings as were advanced in connexion with the results obtained with serum T 67.

The results so far obtained may be summarized thus :—

(i) All the cultures from serum institutes so far examined react with the "U.S.A. agglutinating serum."

(ii) Of six cultures obtained from wound exudates:—

(*a*) Only one reacts with that serum,

(*b*) Three react with "67" serum,

(*c*) Two react with "R 220 serum."

(5) *Agglutination of Cultures by Serum of Animals immunized against T 80 and T 72.*—In order to corroborate the findings tabulated in Tables VII and VIII, culture T 80 B 1 and culture T 72 BRA were used for immunizing animals.

The latter gave rise to tetanus in the rabbit on the second day after the second inoculation. The animal was killed at once with the result that this serum is of somewhat low titre—1/200, Table IX, p. 652.

These results therefore agree with those tabulated in Tables VII and VIII.

(6) *Note on a Possible Source of Error that must be excluded before the Validity of the above Results can be accepted.*—It might be argued that the isolation of the toxic cultures from wounds by the aid of the special medium had modified the organisms in such a way that they had assumed new qualities in respect of their serological reactions.

TABLE IX.

Register number of culture	"T 72 B R A agglutinating serum"			T 80 B i agglutinating serum			Normal serum
	$\frac{1}{50}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$	$\frac{1}{50}$
U.S.A. II	–	–	–	–	–	–	–
U.S.A. I	–	–	–	–	–	–	–
U.S.A. Whole ..	–	–	–	–	–	–	–
Tet M	–	–	–	–	–	–	–
Tet M B 4	–	–	–	–	–	–	–
Tet Kollo	–	–	–	–	–	–	–
Tet Q	–	–	–	–	–	–	–
Tet 0 B 8	–	–	–	–	–	–	–
T 3 iv D 3	–	–	–	–	–	–	–
T 67 R viii	–	–	–	++	++	(+)	–
T 72 B R A	++	++	+	–	–	–	–
T 79 iv..	–	–	–	++	++	++	–
T 80 B i	–	–	–	++	++	++	–
R 220 Sp	++	++	+	–	–	–	–
Control	++	++	+	++	++	++	–

Such argument is by no means frivolous, for Bordet found that the agglutination reactions of the whooping-cough bacillus varied considerably according to the medium upon which it was grown.

To exclude this as a possible source of error the tetanus U.S.A. culture was subcultured for three generations, each of five days, in the selective medium. The growth obtained was centrifuged, suspended in saline, and dealt with according to the technique described in Part II, Section A (1).

This emulsion was then exposed to the sera corresponding to cultures U.S.A., T 67 and R 220, full controls being included in the experiment. The following result was obtained:—

TABLE X.

Culture—and how obtained	U.S.A. II agglutinating serum			T 67 agglutinating serum			R 220 agglutinating serum		
	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{400}$
Ordinary broth culture U.S.A. II	++	++	++	–	–	–	–	–	–
Putrescent broth culture U.S.A. II	++	++	++	–	–	–	–	–	–
Ordinary broth culture T 67	–	–	–	++	++	++	–	–	–
Ordinary broth culture R 220	–	–	–	–	–	–	++	++	++

The above result shows that the organisms remain true to type when grown in the selective medium.

(C) *Agglutination Experiments with Non-toxic Cultures of End-sporing Bacilli.*

It might still be argued, notwithstanding the results tabulated in Table VI, that the agglutination of cultures T 67, T 79 and T 80 with one serum, and the similar result in the case of T 72 and R 220 with another, might be due to the presence of a common contaminator in each instance. It was therefore necessary to investigate by serological methods a number of cultures which superficially resembled *B. tetani*, but which proved, either before or after application of the agglutination test, to be non-pathogenic to animals. All these cultures were obtained from wounds, developed spherical, or almost spherical, terminal spores in the selective medium, and before examination were isolated in a fair state of purity.

The technique used in the examination of these was similar to that employed in investigating the toxic growths.

TABLE XI.

Register number of culture	U.S.A. agglutinating serum		T 67 agglutinating serum		R 220 agglutinating serum		Pseudotetanic agglutinating serum		Sporogenes agglutinating serum		R 27 CD 5 agglutinating serum		Normal serum
	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{100}$	$\frac{1}{200}$	$\frac{1}{50}$
T 68, KV, I ..	−	−	−	−	−	−	−	−	−	−	−	−	−
T 68, KV, VII	−	−	−	−	−	−	−	−	−	−	−	−	−
R 27. CD 5 ..	−	−	−	−	−	−	−	−	−	−	++	++	−
T 74, O 6 ..	−	−	−	−	−	−	−	−	−	−	++	++	−
T 74, O 3 ..	−	−	−	−	−	−	−	−	−	−	++	++	−
T 69, O 3 ..	−	−	−	−	−	−	−	−	−	−	++	++	−
T 69, O 6 ..	−	−	−	−	−	−	−	−	−	−	−	−	−
T 68, KV-3 ..	−	−	−	−	−	−	−	−	−	−	+	(+)	−
T 69, KV 3 ..	−	−	−	−	−	−	−	−	−	−	−	−	−
R 68, CD 5 ..	−	−	−	−	−	−	−	−	−	−	−	−	−
U.S.A... ..	++	++	−	−	−	−	−	−	−	−	−	−	−
T 67	−	−	++	++	−	−	−	−	−	−	−	−	−
R 220	−	−	−	−	++	++	−	−	−	−	−	−	−
Pseudotetani ..	−	−	−	−	−	−	++	++	−	−	−	−	−
Sporogenes ..	−	−	−	−	−	−	−	−	++	++	−	−	−
R 27, CD 5 (control)	−	−	−	−	−	−	−	−	−	−	++	++	−

It seems improbable then that a common contaminating organism is the determining factor in the agglutination of T 67. T 79 and T 80 and of R 220 and T 72, for it is almost certain that

the same common contaminator would have been present in one at least of the non-toxic cultures.

The other point calling for comment in the above result is that there is certainly more than one non-toxic end-sporing bacillus, excluding of course *B. pseudotetani*. One that is present with considerable frequency corresponds to the culture R 27 CD 5.

Those that have failed to agglutinate in presence of the serum specific to that organism are still under examination and I have reason to believe that there are several serological types in this non-toxic group as in the toxic groups of end-sporing bacilli.

(D) *Absorption of Agglutinins Test with the Three Types of Tetanus Bacillus recognized by the Agglutination Reaction.*

In order further to corroborate the agglutination results detailed in Part II, Section B, 2, 3, and 4, I chose two specimens of each type of bacillus for investigation by means of the absorption of agglutinins test.

Technique.—4·9 cubic centimetres of 2,000 million suspension of organisms was taken, and to it was added 0·1 cubic centimetre of the serum to be absorbed. The tube containing the serum-organism mixture was incubated for twenty-four hours at 37° C., the degree of agglutination noted and thereafter centrifuged in order to obtain a clear supernatant fluid. This clear supernatant fluid was pipetted off and employed as an agglutinating serum.

Six strains of bacilli and three sera were examined by this method and the results shown in Table XII were obtained.

The following conclusions therefore seem permissible from this section of the work.

(*a*) That there are at least three antigenic types of *B. tetani*.

(*b*) That these remain true to type both in respect of the agglutination test and the absorption of agglutinin reaction.

(E) *Can Culture in the special Medium, followed by Agglutination of the Culture so obtained, be made use of for determining the Presence of B. tetani of one or another Type in Wound Exudate?*

While recognizing that it is, in the present state of our knowledge, highly improbable that a technique based on differential culture, followed by agglutination, would be as delicate a test for the presence of *B. tetani* as is the classic toxin experiment performed on animals, I submit that such a procedure should be given an extended trial.

Examination by this method, should it prove only partially successful, would give information concerning the relative frequency in wound exudates from cases of the disease, of the three serological types of tetanus bacilli so far differentiated.

TABLE XII.

Saturation of "U.S.A. Agglutinating Serum."

	Unsaturated serum			Saturated serum. Homologous bacillus added			Saturated serum. Test bacillus added		
	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400
U.S.A. II	++	++	++	−	−	−	−	−	−
U.S.A. (Whole) ..	++	+	+	+	−	−	−	−	−
T 67 R viii	−	−	−	++	++	++	−	−	−
T 80 B i	−	−	−	++	++	++	−	−	−
R 220 Sp	−	−	−	++	++	++	−	−	−
T 72 B R A	−	−	−	++	++	++	−	−	−

Saturation of "67 Agglutinating Serum."

	Unsaturated serum			Saturated serum. Homologous bacillus added			Saturated serum. Test bacillus added		
	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400
U.S.A. II	−	−	−	++	++	++	−	−	−
U.S.A. (Whole) ..	−	−	−	++	++	++	−	−	−
T 67 R viii	++	++	++	−	−	−	−	−	−
T 80 B i	++	++	+	−	−	−	−	−	−
R 220 Sp	−	−	−	++	++	++	−	−	−
T 72 B R A	−	−	−	++	++	++	−	−	−

Saturation of "R 220 Agglutinating Serum."

	Unsaturated serum			Saturated serum. Homologous bacillus added			Saturated serum Test bacillus added		
	1/100	1/200	1/400	1/100	1/200	1/400	1/100	1/200	1/400
U.S.A. II	−	−	−	++	++	++	−	−	−
U.S.A. Whole	−	−	−	++	++	++	−	−	−
T 67 R viii	−	−	−	++	++	++	−	−	−
T 80 B i	−	−	−	++	++	++	−	−	−
R 220 Sp.	++	++	++	−	−	−	−	−	−
T 72 B R A	++	++	++	−	−	−	−	−	−

In addition to determining the relative frequency with which the three types occur, it is also of importance to know :—

(*a*) Whether any particular type is frequent in early cases or in late cases.

(*b*) Whether any one type (i.e., serological type) is especially virulent to man.

(*c*) Whether any one type is to be especially associated with local tetanus.

(*d*) Whether the serotherapeutic or prophylactic value of a given mark of serum bears any relationship to the type of the infecting organism, and so to the type of organism with which the serum has been prepared.

By the agglutination method alone can these problems be investigated.

The following experiments were, therefore, carried out: A number of cultures in meat—some dating from October, 1916—were subcultured in the enriching medium, and a further number of growths were also obtained by seeding material direct from wounds into the same medium. The tubes were incubated aerobically, and after four days' incubation at 37° C. the growths were filtered through a loose plug of cotton wool to remove detritus.

This filtrate was then centrifuged and microscopical preparations made from the deposit. If these preparations showed that organisms, liable to be mistaken for *B. tetani* on account of their morphology, were present in overwhelming numbers, the deposit was suspended in saline, heated to 65° C. for thirty minutes, standardized by the opacity method and finally carbolized.

It is to be noted that in making microscopical examination of the preparations from the deposit in these tubes, I did not draw fine morphological distinctions, as daily examination of cultures in a number of media show that *B. tetani* is by no means constant as regards length, breadth, depth of staining, etc.

One feature that is constant is that the spore of *B. tetani* is spherical, but many of the non-toxic end-sporing bacilli develop a spherical, or almost spherical, terminal spore. This is especially liable to occur when these organisms are grown in the putrefied meat broth.

The suspensions made from these centrifuged deposits were exposed to the action of a number of agglutinating sera (*vide* table XIII).

At the same time as the tube of special broth was inoculated, a similar tube of ordinary broth was seeded in duplicate. The

ordinary broth tubes were incubated anaerobically for eight days, after which time one cubic centimetre of the culture was injected subcutaneously into a rat. Rats were used owing to the difficulty of obtaining guinea-pigs.

The following results were obtained :—

TABLE XIII.

Registered number of cultures	How obtained. Growth for four days in selective medium from :	U.S.A. serum	T 67 serum	R 220 serum	Pseudo-tetani serum	Sporogenes serum	R 27 CD 5 serum	Normal serum	Result of animal inoculation
		$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{50}$	$\frac{1}{50}$	
3	Old meat culture ..	++	–	–	–	–	–	–	Tetanus within 24 hours
T 28	,, ,, ..	–	–	–	–	–	–	–	Animal healthy
T 32	,, ,, ..	–	–	–	–	–	–	–	,, ,,
T 35	,, ,, ..	–	–	–	–	–	–	–	,, ,,
T 47	,, ,, ..	–	–	–	–	–	–	–	,, ,,
T 65	,, ,, ..	–	–	–	–	–	++	–	,, ,,
T 77	,, ,, ..	–	–	–	–	–	–	–	,, ,,
T 81	Growth from wound material	–	++	–	–	–	–	–	Tetanus within 24 hours
T 83	,, ,, ,,	–	++	–	–	–	–	–	,, ,, ,,
T 84	,, ,, ,,	–	–	–	–	–	–	–	Local tetanus 48 hours
T 85	,, ,, ,,	–	–	++	–	–	–	–	Tetanus within 24 hours
T 86	,, ,, ,,	–	–	–	–	–	–	–	Animal healthy
T 87	,, ,, ,,	–	–	–	–	–	++	–	,, ,,
T 88	,, ,, ,,	–	++	–	–	–	++	–	Tetanus within 24 hours
T 89	,, ,, ,,	–	–	–	–	–	–	–	Local tetanus 4th day
T 90	,, ,, ,,	–	++	–	–	–	–	–	Tetanus within 24 hours
T 91	,, ,, ,,	–	–	–	–	–	–	–	Animal healthy

The results are striking, for they show that with the method employed the majority of toxic cultures give a positive reaction in presence of one or other of the three type agglutinating sera. In fact, if *B. tetani* be present in fair numbers in the inoculum, its presence can be demonstrated frequently by this method.

In the case of T 84 and T 89, *B. tetani* appear to have been present only in small numbers, if the late development of symptoms can be accepted as evidence of paucity of the organism. It is of course possible that these organisms which failed to react in presence of the agglutinating sera, represent a fourth type of *B. tetani.* This hypothesis appears to me to be improbable, but the growths are being purified and further investigated.

With reference to culture T 84, this organism has been grown for four generations in the selective medium. It now reacts with the sera corresponding to the toxic cultures in the manner indicated in the following table.

TABLE XIV.

T 84 after Four Generations in Selective Medium	U.S.A. Serum	T 67 Serum	R 220 Serum	Pseudotetani Serum	Sporogenes Serum	R 27 CD 5 Serum	Normal Serum
	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{50}$	$\frac{1}{50}$
T 84	—	+	—	—	—	—	—

Culture T 89 so far gives the same reactions as those indicated in Table XIII.

(*F*) *Agglutination of Toxic Tetanus Cultures obtained from Wound Exudates in Men not suffering from Tetanus.*

In the course of her investigations into the anaerobic flora of wounds, Miss Robertson demonstrated the presence of toxic organisms in a small number of cultures made from wounds in men not suffering from tetanus.

Miss Robertson kindly placed these at my disposal, and I examined them by the agglutination method. So far I have only investigated four of these, and the results obtained are tabulated in Table XV.

TABLE XV.

Register number of culture	How obtained: Cultures to be agglutinated grown for four days in the selective medium from	U.S.A. serum	T 67 serum	R 220 serum	Pseudotetani serum	Sporogenes serum	R 27 CD 5 serum	Normal serum
		$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{50}$	$\frac{1}{50}$
R 27 (Whole)	Sub-culture from toxic broth culture (Miss Robertson)	+ +	—	—	—	—	+	—
R 62 ..	Sub-culture from toxic broth culture (Miss Robertson)	+	—	—	—	—	—	—
R 68 ..	Sub-culture from toxic broth culture (Miss Robertson)	+ +	—	—	—	—	—	—
R 146 ..	Sub-culture from toxic broth culture (Miss Robertson)	—	+ +	—	—	—	—	—

It is interesting to note that the non-toxic culture R 27 CD 5 was isolated from the whole culture R 27, which, as is seen from the above table, contains a toxic tetanus bacillus of the U.S.A. type. The culture R 27 was obtained from a man forty-nine days after the infliction of his wound. He had received one dose of tetanus antitoxin on the day of wounding. Cultures R 62 and R 68, which

are also of the U.S.A. type, were both obtained on the fifty-sixth day after the infliction of the wound. In the case of one of these, the man is not clear whether he had, or had not, received a dose of antitoxin at the time of wounding. Culture R 146 was obtained on the eighth day after wounding. A dose of antitoxin had been administered in this case. Re-examination of the wound made thirty days after its infliction showed that no anaerobic organisms of any kind whatsoever were present in the exudate.

It is significant that three of these four toxic cultures obtained from men not showing evidence of intoxication are of the U.S.A. type, particularly in view of the fact that of the cultures obtained up to the present from actual cases of tetanus, occurring for the most part in inoculated men, only one culture of the U.S.A. serological type has been obtained.

(G) *Discussion of Results obtained.*

The results obtained show that there are at least three serological types of tetanus bacilli, but this does not necessarily mean that these types, although different, as bacillary antigens develop three specific toxins.

So far I have not had the opportunity of preparing antitoxins specific to each type, and of testing these by crossed experiment against the homologous and heterologous toxins, and therefore can offer no information on this point. It is, however, essential that crossed toxin-antitoxin experiments of this kind should be carried out, and I propose to undertake this investigation at once.

With reference to this question of specificity of toxin, it is interesting to note that Leuchs (*Zeit. für Hyg.*, 1910, Bd. 65, p. 55) calls attention to such specificity of toxin-antitoxin relationship in the case of two strains of *B. botulinus.* One might summarize his results thus: "That an antitoxin prepared by inoculating the toxin of either, had some neutralizing action on the toxins of both, but that the neutralizing value, estimated quantitatively, of one antitoxin was greater for the homologous than for the heterologous toxin."

It may be that in tetanus we are dealing with a similar phenomenon, and I would strongly urge that, even should the experiments I propose to undertake show that there is not a marked specificity of reaction between toxin and antitoxin corresponding to the bacillary types, animals should nevertheless be immunized against toxin from all three types of the bacillus. It is necessary,

too, that the "typing" of toxic cultures from wounds be proceeded with, as it is important that we should know how frequently each type is present in a series of cases.

Further, the differentiation of the organism into a number of types offers a new field of inquiry—"Does it ever happen that in a wounded man, whose wound contains *B. tetani*, agglutinins for that organism are developed before there is evidence of intoxication?" Notwithstanding the fact that in the past such inquiry has given disappointing results, I feel that in view of what we now know concerning the multiplicity of types of *B. tetani* this aspect of the problem should again be made the subject of investigation.

Conclusions.

The following conclusions seem permissible from the experiments described in this communication.

(1) There are at least three serological types of *B. tetani.*

(2) In cases of tetanus among the wounded in this country, the causal bacilli do not appear to correspond serologically with the type commonly employed at the present time for the preparation of antitoxin. On the contrary, among the small number of strains of the bacillus that have so far been obtained from wounds in men who show no evidence of tetanus the predominant type does correspond to that used for the preparation of antitoxin.

(3) In cases of tetanus, the type that so far has been of most frequent occurrence corresponds to culture T 67. Out of 11 toxic cultures 7 belong to this group, 3 to the group typified by R 220 and 1 to the U.S.A. group.

(4) Useful information may be gained by the use of the technique described in Part II, Section D, of this paper.

(5) There is a symbiotic factor at work in wound infections with the anaerobic bacilli. The nature of this symbiosis is suggested in Part I.

(6) Bacilli whose morphology is such that they are liable to be mistaken for *B. tetani*, but are non-pathogenic, are frequently present in the exudates from wounds of men suffering from tetanus.

(7) The presence of such organisms in cultures made from wound exudates is indicative of the state of the wound being such that if *B. tetani* gain access to the part, it will grow readily.

(8) Such cultures as Tet. M.B. 4 (Table VI) and T 88 (Table XIII) indicate that the presence of an end-sporing bacillus corresponding to R 27 CD 5 does not prevent the formation of toxin.

(9) It is known from the animal experiments indicated in Table XIII that the presence of *B. sporogenes* does not markedly inhibit the production of toxin.

I here wish to express my gratitude to my friends who have so generously assisted me in the prosecution of this investigation.

My thanks are also due to Surgeon-General Sir David Bruce, C.B., F.R.S., for inviting me to undertake the work, to the Director of the Lister Institute of Preventive Medicine for placing a laboratory at my disposal and to Lieutenant-Colonel Gordon, C.M.G., for much advice and encouragement.

In a very special manner I am indebted to Miss Robertson for her valued advice and assistance in the isolation of cultures, to Mr. Robbins and the other members of the junior staff of the Lister Institute for freely proffered assistance, and to my laboratory attendant, Pte. H. C. Wilson, for his valuable aid, in work which for long was discouraging and was not infrequently laborious.

THE MICROSCOPIC EXAMINATION OF THE BRAINS OF TWO MEN DEAD OF COMMOTIO CEREBRI (SHELL SHOCK) WITHOUT VISIBLE EXTERNAL INJURY.[1]

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The examination of the brains of two cases of death from shell shock without visible injury and without punctate hæmorrhages indicative of gas poisoning is of interest for several reasons. So far as I know, it is the first description that has been given which serves to explain (1) sudden death in shell shock, and (2) the clinical symptoms which persist for some time after the commotion of the brain in non-fatal cases.

I am indebted to Lieutenant-Colonel T. R. Elliott and Professor Arthur Keith for sending me the brains, and to the officers whose names are mentioned for the clinical notes and the notes of the post-mortem examination.

Case 1.—Clinical Notes.

In this case the man developed, according to a note furnished by Captain J. London, a degree of nervousness on the Somme which he never lost, but was able to control for six months. Later he was in an area which was subjected to an intense bombardment, during which, as far as can be ascertained, no gas shells were used. This lasted about four hours (February 22, 4 p.m. to 8 p.m.). Although he remarked to another man that "he could not stand it much longer," he did not give way until the following day, twelve hours later, when perhaps six shells came over (February 23, 8 a.m.).

He was not buried nor gassed. One shell burst just behind his dug-out—namely, ten feet away—in the morning, but many must have been as near the previous day. Early symptoms were tremors and general

[1] The expenses connected with the microscopic investigation and illustration of this communication have been defrayed by a Government grant of the Board of Control.

depression. The later symptoms (February 22) were coarse tremors of the limbs, crying (February 23), inability to walk or do anything. He would not answer questions—very like the hysterical manifestations of melancholia. The pupils were dilated. I was rather busy with some wounded at the time, and did not make a detailed examination.

A note by Captain Francis A. Duffield, R.A.M.C.(S.R.), states that the man was admitted to the field ambulance in the evening in a state of acute mania, shouting "Keep them back, keep them back." He was quite uncontrollable and quite impossible to examine. He was quieted with morphine and chloroform, and got better and slept well all night. In a later note, Lieutenant-Colonel F. J. Crombie, in command of the field ambulance, stated that the patient had at least two hypodermic injections of morphine while in the ambulance. Next morning he woke up apparently well, and suddenly died.

Necropsy.

The following is a note by Captain A. Stokes, R.A.M.C. (Mobile Laboratory), on the post-mortem examination made on the afternoon of the day of death.

There were no marks of external violence on the body other than some small scratches on the chest wall.

Thorax.—The lungs were œdematous, and in the substance of the lower lobe of the left lung there was a considerable hæmorrhage. The right lung, except for œdema, was normal.

Heart.—Enlarged, and the right side dilated. The muscle was good, and there were no valvular lesions.

Abdominal Cavity.—Normal. There was no pathological change in the stomach, œsophagus, intestine, or great intestine. The liver was normal in size, and was somewhat congested. The spleen was normal. The kidneys were small, but showed no gross change. The urine contained neither sugar nor albumin.

Skull.—There was a slight bruise on the scalp, in the frontal region. The brain was extremely congested, and on each side of every superficial vessel there was an ecchymosis. There were a number of minute punctiform hæmorrhages at the terminations of the smallest vessels on the surface of the brain. The whole brain was soft but not markedly œdematous. The cerebrospinal fluid appeared to be blood tinged. There was considerable ecchymosis on each side of the great sinuses of the skull. There was no large hæmorrhage found, and no small intracerebral petechiæ. There was no gross lesion of the viscera, which would have been a cause of death; but though I have never seen a post-mortem examination on a man who has died of "shell shock," I consider the condition of the brain is consistent with that diagnosis.

MICROSCOPIC EXAMINATION OF THE BRAIN OF CASE 1.

The brain had been preserved in Kaiserling's fluid, and it was not in very good condition, but seeing that it was placed in this fluid less than twelve hours after death, it is probable that the portions examined yielded satisfactory material for microscopic investigation.

The portions of brain selected were prepared for section by the paraffin method of serial sections. The dyes used to stain the sections were as follows: (1) Hæmatoxylin and eosin; (2) Van Gieson; (3) thionin; (4) polychrome and eosin. The sections were five microns in thickness and were mounted, after staining, in Canadà balsam..

Cerebrum: Top of Ascending Frontal Convolution; Leg Area.—The veins are congested both in the meninges and in the substance of the grey and white matter. There is subpial hæmorrhage here and there owing to rupture of the dilated congested veins. There are *no punctate hæmorrhages* observable. The perivascular spaces of the arterioles, capillaries, and venules are dilated, also the perineuronal spaces are distinctly seen, some being apparently connected with the perivascular spaces. In some of the sections, empty collapsed vessels can be discerned in places. The general appearance suggests deficiency of blood in the arteries and capillaries, with engorgement of the venous system. A condition very similar to that observed in experimental anæmia in animals produced by ligation of both carotids and vertebrals. There is some degree of chromatolysis of the cells. The Betz cells are the easiest on account of their size to recognize this change, and the accompanying drawing (fig. 1) shows the early chromatolysis of these psychomotor neurones. The pole of the first frontal shows marked congestion of the vessels and some subpial hæmorrhage from dilated congested veins. Many of the arterioles and capillaries are empty and collapsed, and there is the same appearance of dilation of the perivascular sheaths and perineuronal spaces. The pyramidal cells also show early chromatolytic changes.

Internal Capsule.—There is general congestion of veins, and the small vessels appear to be either empty and collapsed, or contain less blood than normal. Some of the vessels show hæmorrhage into the sheath. (Fig. 2.)

Corpus Callosum.—The small vessels are congested and dilated, some have ruptured into the sheath, other small vessels have ruptured into the tissue. There are no typical punctate hæmorrhages

such as are seen in gas poisoning, which are due to hyaline thrombosis of terminal arterioles.

Pons.—There is a marked congestion of veins and some of the smaller veins have ruptured, giving rise to hæmorrhage into the sheath, blood corpuscles are also seen extravasated in the adjacent nervous tissue. There are small hæmorrhages in the white matter (fig. 3). There is dilatation of the perivascular sheaths and perineuronal spaces together with collapsed and empty vessels or partially empty vessels. The hæmorrhages, here as elsewhere, appear to be of recent occurrence. Nearly all the cells show some degree of early chromatolytic change.

Medulla.—Sections of the medulla at the point of the calamus scriptorius were made, as the upper part of the medulla was rather damaged. In the anterior median fissure a vessel had ruptured, and there were free corpuscles in the lepto-meninges. All the veins on the surface of the medulla were congested. In serial sections the ruptured vessel entering the anterior median fissure and penetrating the median raphe could be followed, and here it was seen to have ruptured into the perivascular space (fig. 4), and blood corpuscles are seen extravasated into the adjacent tissue. The perivascular and perineuronal spaces are seen dilated both in the medulla and pons (fig. 7). The cells of the medulla show only chromatolytic changes as a rule. The cells of the vago-accessorius nucleus (fig. 5) show much more chromatolysis than the adjacent cells of the hypoglossal nucleus (fig. 6). These nuclei are distant about two millimetres from the ruptured vessel in the median raphe.

Cerebellum.—Sections stained with thionin and safranin show very unequal staining of the Purkinje cells with the basic dye (fig. 10). This condition is very similar to that described by Crile in the case of "a soldier who had suffered from hunger, thirst, and loss of sleep; had made the extraordinary forced march of 180 miles from Mons to the Marne; in the midst of that great battle was wounded by a shell; lay for hours waiting for help, and died from exhaustion soon after reaching the ambulance."

Summary of Histological Changes.

There is a generalized early chromatolytic change in the cells of the central nervous system. This change varies in intensity. The cells most affected are the small cells in which the basophil substance has almost disappeared. In the larger cells the Nissl

granules are smaller and not packed so closely together as normal. The small cells of the medulla and pons are slightly swollen, and the nucleus is large and clear. This change is present in some of the large cells, but it is less evident. This change indicates a relative degree of exhaustion of the kinetoplasm; assuming that the amount of the basophil substance is an index of biochemical neuropotential. The Nissl granules are not present in the neurone during life, but they disappear altogether in a cell that (prior to death of the whole body) has been so injured as to decay and die. Granted this premise, then, it may be assumed that the cells of this man are in a state of commencing nervous exhaustion, some nuclei of cells showing the changes more markedly than others—for example, the cells of the vago-accessorius nucleus.

The vessels of the pia-arachnoid membranes of the brain are congested, and there are scattered subpial hæmorrhages of microscopic size almost everywhere.

In the white matter of the corpus callosum, the internal capsule, the pons, and medulla there are seen congested veins and hæmorrhage into the sheaths of these vessels with occasionally extravasation of blood corpuscles into the adjacent tissues.

Case 2.—Clinical Notes.

Captain Duffield reported that information obtained from the medical officer attached to the unit in which the man, a gunner in the Royal Garrison Artillery, was serving, was to the effect that he was sitting in a corrugated iron hut, fifty yards from some boxes of cordite cartridges, when a shell landed and exploded them. The man became unconscious at once, his breathing was stertorous: his body showed no signs of wounds.

On the same day he was removed to a dressing station and thence to a casualty clearing station; in the evening of that day he died. The medical officer there stated that the patient was absolutely unconscious, and could not be roused. His breathing was stertorous and slow; the pupils were equal and reacted to light; knee-jerks were difficult to obtain. He died shortly afterwards, and at the post-mortem examination the brain was removed, placed in spirit, and dispatched.

Macroscopical Appearance of Brain of Case 2.

On the upper surface of the cerebellum, the temporo-sphenoidal, and left orbital lobes there was superficial hæmorrhage. On cutting up the pons, oval patches were seen as large as $\frac{1}{6}$ by $\frac{1}{4}$ inch; whether

this is simple staining of hæmorrhage cannot be determined until a microscopical examination has been made. Portions of the mesencephalon and pons were taken for microscopical examination; the medulla oblongata was not sent.

Microscopical Examination.

Post-parietal.—Meninges: Marked congestion of all vessels of the surface of the brain with extravasation of blood into the soft membranes. In the grey matter of the cortex the perivascular spaces are dilated throughout, and the capillaries, veins and arteries are for the most part empty. In the white matter no punctate hæmorrhages are seen; there is marked dilatation of the perivascular spaces; the capillaries, veins, and arteries are empty. In the cortex there is dilatation of the perineuronal spaces, which in many instances may be seen communicating with the perivascular spaces. (Fig. 8.)

Ascending Frontal.—Stained with thionin. The large pyramidal cells show pretty marked chromatolysis without swelling of cell; some of the Betz cells show commencing breaking up of the tigroid bodies; smaller pyramidal cells show undoubted swelling of nucleus and loss of pyramidal shape, very similar to that observed in experimental anæmia in animals, with varying degrees of chromatolysis. As a rule, the smaller the cell, the more marked is the change. (Fig. 9.)

Orbital Lobe.—On the under surface there is extensive extravasation of blood into the substance of the brain and on the surface, and there is very marked dilatation of the perivascular spaces everywhere. The cortex is in a measure destroyed in one place; there is very marked dilatation of perineuronal as well as perivascular spaces, which intercommunicate.

Corpus Callosum.—There is much congestion of vessels, and many have ruptured into the sheath, forming long, irregular branching, hæmorrhagic extravasations, but no sign of punctiform hæmorrhage.

Temporo-Sphenoidal Lobe.—Shows remarkable dilatation of the perivascular spaces, and there is a big globular hæmorrhage, and much hæmorrhage into the substance of the brain.

Opinions of French and German Officers regarding "Shell-Shock" by Windage.

Many discussions have taken place by French and German neurologists regarding the question of organic changes occurring in the central nervous system as a result of *vent du projectile* or windage. According to Léri, a true commotion appears only to be produced at a proximal distance of some ten metres from great projectiles. The finding of groups of men dead in the last attitude of life, in closed spaces such as the German "pill-boxes" and concrete dug-outs, and the proven fact that enormous forces of compression and decompression are generated by the detonation of high explosives in great shells, aerial torpedoes, and mines has lent support to the view that mere proximity to the explosion is sufficient to cause organic changes in the brain and spinal cord by the compression and decompression of gases, the result of the explosion, and of the atmospheric air; altogether apart from actual concussion caused by violent contact with solid materials, such as sandbags or the earth forming the walls of a dug-out, which may at the same time cause burial or partial burial, unattended by visible evidence of injury of the body sufficient to account for symptoms of cerebral or spinal concussion. The patient is rendered unconscious and his mind is a blank concerning what happened, in a true case of commotio cerebri; consequently he is unable to say whether he had or had not been concussed by the sand or earth. In the two cases under consideration there was no history of burial.

Undoubtedly the vast majority of non-fatal cases of shell-shock are more emotional in origin than commotional, and occur especially in subjects of an inborn neurotic or neuropathic temperament; but the two conditions may be associated. Both Léri and Meige emphasize the fact that commotional symptoms are not influenced by psychotherapy. They also point to the fact that in cases where organic changes have occurred the cerebrospinal fluid withdrawn by lumbar puncture exhibits macroscopic or microscopic evidence of blood indicating that hæmorrhage had occurred.

In Case 1 Captain Stokes noted at the post-mortem examination that the fluid was blood-stained, and the microscopic findings of ruptured vessels explain this.

Léri states that the subjects of commotion are generally depressed, asthenic, aboulic, and often more or less confused mentally; they present almost constantly, even in light cases, pro-

nounced disturbances of voltaic vertigo. They often suffer with bleeding from the ear, or nasal or vesical hæmorrhage. Roussy and l'Hermitte admit that in rare cases "vent du projectile" may cause organic changes.

Robert Bing gives a review of the German opinions upon nervous accidents determined by the near explosion of a projectile. He points out that Vogt and Gaupp, who have occupied themselves with "Granat Kontusion" (bomb contusion), are far from accepting the exclusive psychogenic rôle in the development of this syndrome. Gaupp insists particularly upon the relations which exist between the initial symptoms presented by those patients and the rapid succession of atmospheric compression and decompression which takes place at the moment of the bursting of the projectile. The existence of labyrinthine lesions, almost regularly in this class of case, is in support of this opinion (Schultze and Meyer).

In von Sarbo's numerous publications upon the subject there is a tendency to regard these cases from a uniform point of view. For him the general mass of observations do not permit the diagnosis of organic changes in the usual sense of the word, nor that of psycho-neurosis. He believes microstructural alterations occur, but which are not equivalent to the molecular changes of Charcot. He includes in the microstructural changes meningeal œdema, microscopic hæmorrhages, transitory paralysis of vessel walls, and contusion of the nuclei and centres. In the initial period these lesions may give rise to some discrete symptoms of organic disease; later they are manifested by functional physical and psychical symptoms. Bing remarks that the pseudo-neurasthenia of arteriosclerosis supports this view. It is interesting to note that the hæmorrhages into the perivascular sheaths of vessels observed in Case 1 resemble in some respects those seen in arteriosclerosis.

Oppenheim's view of traumatic neuroses had few supporters at the Congress at Munich.

Aschaffenburg examined soldiers in Flanders who had been exposed to shell fire in the trenches but had escaped unwounded and were apparently well. The examinations took place in most cases within twenty-four hours after leaving the trenches. Of seventy-four men so examined, sixty-seven showed unmistakable signs of localized organic lesions of the nervous system, although not as a rule of a serious nature. A second examination a week later showed that some, but not all, of these phenomena had disappeared. Here were cases, therefore, in which an organic basis was present but no traumatic neuroses had developed. Aschsffenburg gives the result of his experience in these words:—

"In assuming organic changes one of the consequences of shell explosion I do not thereby agree with Oppenheim that the nervous symptoms are to be attributed to these changes. On the contrary it is to be noted that the most exaggerated hysterical cases which develop after exposure to shell firing are the ones which exhibit organic symptoms least of all."

Hypotheses regarding the Lesions of "Commotion."

Two hypotheses have been put forward to explain organic lesions by "commotion."

(1) Compression of the gas and atmosphere, so that the cranium and spine are struck, as it were, by a solid body and the vibration is transmitted through the bony structures to the cerebrospinal fluid and thence to the brain and spinal cord, causing a molecular disturbance of the delicate colloidal structures of the neurones particularly those of the nuclei in the floor of the fourth ventricle where the fluid is most abundant, and where it acts as a water cushion upon which the vital cardio-respiratory centres rest.

(2) Compression is followed by a corresponding decompression causing the liberation of bubbles of gas in the blood and tissues leading to embolism.

Probably both the forces of compression and decompression act in producing vascular disturbances in the central nervous system, causing arterio-capillary anæmia and venous congestion and rupture of delicate-walled vessels with microscopic hæmorrhages.

COMMENTARY.

In Case 1, of which I have described the histological changes, it may be observed that there was a condition of mania during life; this maniacal excitement may be correlated with the marked venous congestion of the cortex, the microscopic subpial hæmorrhages, and a certain degree of scattered arterio-capillary collapse and emptiness. This, however, could not be held responsible for the suddenly fatal termination; the hæmorrhage into the sheath of a fair-sized vessel (see fig. 4) in the median raphe of the medulla and the generalized congestive venous stasis, with a condition of exhaustion of the cells of the vago-accessorius nucleus (as shown by the almost complete disappearance of the Nissl granules (see fig. 5) as compared with the cells of the adjacent hypoglossal nucleus), coupled with the condition of the heart found post mortem, may explain the sudden death.

The cerebral anæmia, as shown by collapsed and empty arterioles and capillaries with dilated perivascular and perineuronal spaces (see figs. 7 and 8), similar to the appearances in sections of brains of animals that have been killed within a few days of ligation of both carotid and vertebral arteries. The veins are congested similarly, but the capillary anæmia would explain many of the symptoms of sufferers with true shell shock, namely, headache, giddiness, amnesia—anterograde as well as retrograde—dizzy feelings, lack of power of attention, and fatigue—stupor, inertia, mental confusion, terrifying dreams—symptoms which are generally met with in recent cases.

There is, in both Cases 1 and 2, a general, though as a rule not marked, chromatolytic change indicative of a lack of kinetoplasm in the neurones of variable degree. This may hypothetically, but with reason, be regarded as an expression of a fall in the general store of neuro-potential of the central nervous system. The cells of Purkinje of the cerebellum show especially a complete or partial loss of the basophil substance.

The vascular changes are microscopic and widespread; there are no punctate hæmorrhages of the white matter, such as I have described in gas poisoning, and which are due to a hyaline thrombosis of terminal arterioles. The hæmorrhages are into the dilated perivascular sheaths (see figs. 2 and 3). In the corpus callosum the networks of capillaries and small vessels show fractures and escape of corpuscles into the tissues. The microscopic changes in the brain confirm in every way the opinion expressed by Captain Stokes when he made the post-mortem examination that he was dealing with a case of shell shock.

In Case 2 the extensive hæmorrhage on the under surface of the orbital lobe without visible external injury is of interest. The force of the explosion must have been enormous. What happened to the man when it occurred we do not know. The cortical arterial and capillary vessels were empty, the perivascular sheaths were dilated and filled presumably with cerebrospinal fluid (see fig. 8). The cortical neurones are swollen up, the nuclei are large and clear; the basophil substance is diminished in amount, a condition very like that observed in the cells of the cortex of an animal in which experimental cerebral anæmia had been effected. Owing to the brief clinical and post-mortem notes this case is of much less interest than Case 1.

I am unable to find in the literature at my disposal any description of the microscopic changes in the brains of soldiers dying from *commotio cerebri* without visible external injury.

MICROSCOPIC INVESTIGATION OF THE SPINAL CORD IN A CASE OF PROBABLE SPINAL COMMOTION.

1.—CASE NOTES.

1929 Pte. A. ——, 16th Middlesex. Died July 8, 1916. This man was badly wounded on July 1, 1916, during the early advance. He was brought in from "No Man's Land" on the evening of July 5, 1916, and arrived at the Casualty Clearing Station on the morning of July 6, 1916.

There was a superficial graze (probably caused by shrapnel) over the spine of the left scapula, and a small "in and out" wound over the right gluteal region. This wound was about two inches long, and superficial. It was clean, and the muscles were not involved. He had had tetanus antitoxin (quantity unknown). His mental condition was fairly clear, although somewhat masked by his halting speech and extreme somnolence. He was, of course, much fatigued, and had suffered from lack of food. He had complete paralysis of the legs and abdominal muscles and the left side of the face. There was marked equal loss of power in both arms. Complete anæsthesia from the level of the umbilicus downwards, atony of the bladder with overflow incontinence, and loss of control of the rectum were present.

The pulse varied between 80 and 90 per minute, but was weak in tension. There was no albumin in the urine. He merely became weaker; eventually coma preceded death on July 8, 1916, without any additional symptoms having presented themselves.

Post mortem: complete examination was made, and nothing to account for death was found.

(*Signed*) WILLIAM MOODIE,
Captain R.A.M.C.
O.C. 17 *Mobile Laboratory.*

MICROSCOPIC EXAMINATION OF PORTIONS OF THE SPINAL CORD.

A portion of the spinal cord extending from the eighth dorsal to the fourth lumbar segment was sent to me for examination by my former assistant, Captain Moodie. The material arrived in good condition in formol solution. Portions were blocked in paraffin, and sections of five microns were cut and stained by Van Gieson, Nissl, and Leishman stains; the last named yielded the best results.

The eighth, tenth, twelfth dorsal, first and second lumbar segments were examined; similar appearances, although the changes varied in intensity and degree, were observed in all the sections. Briefly they were as follows: On the surface of the spinal cord blood corpuscles were seen adhering—evidence that the cerebro-spinal fluid had contained blood during life. The veins upon the

surface of the spinal cord were everywhere congested; the arteries and capillaries as a rule were empty. In places the *veins* could be seen *ruptured*, and in some sections *intraradicular hæmorrhage* was observed. In the substance of the spinal cord itself were numerous minute hæmorrhages, varying in size from a pin's head, and visible to the naked eye, to a pin's point, invisible except by aid of the microscope.

The hæmorrhages are seen especially in situations where the surrounding tissue offers least support; consequently they are found in the grey matter of the anterior horns, but especially at the base of the posterior horn near the central canal (*vide* figs. 11 and 12).

Frequently small veins are observable both in the grey and white matter which have ruptured, and numbers of the escaped red corpuscles are seen in the perivascular sheath.

There are distinct changes in the anterior cornual cells of varying intensity. There is perivascular chromatolysis, and not infrequently there is some swelling of the cell and eccentrically placed nucleus (fig. 13). These changes do not seem to bear a direct relationship to the hæmorrhages; it is probable that the finding of these wide-spread capillary and venous ruptures with blood extravasation is important in showing the violence of the commotion to which the delicate fibrils, forming the neuronic synapses in the grey matter, have been subjected. Mechanical compression by the escaped blood corpuscles probably plays only a minor part in producing the loss of function. Had an examination of the cervical cord, of the bulb, and of the pons been made, no doubt similar changes would have been found to account for the symptoms noted. The anæsthesia below the level of the umbilicus likewise may be accounted for by the damage to the grey matter especially noted at the base of the posterior horns.

From the situation of the wounds caused by shrapnel (pieces of the shell ?) it is probable the main effect of the commotion was upon the lower part of the spinal cord.

Bearing upon this question of commotion I will refer to an interesting article by A. Mairet and G. Durante, on the "Commotional Syndrome," which was published in the *Presse Médicale*, June 15, 1917. They have experimented upon rabbits by means of powerful explosives in order to try and find out what happens to soldiers in the trenches.

A charge of melinite or chédite placed at 1·50 metres, then at 1 metre, was successively raised from 125 grammes to 1 kilogramme.

Of twelve animals used five died spontaneously, respectively in five minutes, one hour, one day, eight days and thirteen days after. The others after a momentary unconsciousness with acceleration of respiration and temporary excitement, sometimes rapidly recovered and were killed, with the result that no signs of local lesions were present. Histological examination in all the animals that died showed early lesions consisting of more or less extensive islands of pulmonary apoplexy, caused by rupture of alveolar capillaries. In most cases hæmorrhages and suffusions of blood were found on the surface of the spinal cord, also in the roots between their emergence from the cord and at their conjugation; also limited ruptures of small vessels in the grey matter of the cortex and of the bulb, causing a blood effusion into the perivascular lymphatic sheath, were found.

More rarely perivascular suffusion of the radiate vessels of the medulla oblongata and of small vessels behind the ependyma were observed. The nerve cells were healthy. Vascular changes were found in the anterior horn and spinal ganglia only in two rabbits, and hæmorrhages in the kidney were found in one animal.

The hæmorrhages especially occur from vessels which are badly supported by surrounding tissues, the blood then escapes into the perivascular lympth sheath which does not offer any support. The hæmorrhages are minute, and are diffused, and this fact speaks in favour of a sudden rupture of the wall caused by the decompression which suddenly follows on the wave of compression.

These changes observed by Mairet and Durante are very similar to those which I have described in the cases examined.

It will be noted that in Case 1 there was pulmonary hæmorrhage found at the autopsy.

COMMENTARY.

We do not know what happened to this man, but the shrapnel wounds and the condition of paraplegia, together with the histological microscopic findings in the spinal cord, strongly support the view that a large shell bürst near by, wounding him and causing spinal commotion but without injury of the spine. He may have been blown up in the air and thrown violently on the ground, but this seems unlikely, as the notes state that his mental condition was unimpaired and there was no visible injury of the spine; consequently the most plausible explanation of the cause of the pathological condition of the spinal cord is commotion. No cause for

death could be found except shock. It is a pity that the medulla oblongata and the upper part of the spinal cord with the phrenic nucleus were not sent for examination.

Several cases of spinal concussion without visible signs of injury have been under my care and have so far recovered that they could be discharged from the hospital, and I will briefly relate one case in which I diagnosed spinal commotion and hæmorrhage.

Pte. C., 8th Seaforths, aged 20, was admitted January 5, 1917, with two years' service, six months under fire. On December 22 he was buried in a dug-out by the explosion of an 8·6 shell which struck the back of the dug-out. He was standing up at the time and he remained in the upright position, never lost consciousness, was got out in a few minutes. He was sent to Havre and then to the Maudsley Hospital. Catheterized three days at Havre. On admission he had *incontinence of urine and fæces.*

Sensory Symptoms.

Except slight hyperæsthesia of epigastric region, no sensory disturbances were detected.

There was no evidence of bruising nor any tender spot over the spine.

There was no evidence of paralysis of face or tongue.

There was marked weakness of arm muscles. Right more marked than left. Could grip slightly; he was able to lift arm above head; he was able to turn over in bed. Very slight power of movement in legs, the movement of the knees better than ankles. No muscular wasting, no marked flabbiness. Patellar and ankle clonus on both sides. Plantar extensor on both sides. Wrist tap and triceps jerk obtained easily.

Pupils normal. No ocular paralysis or nystagmus.

Hearing and sight unaffected, also taste and smell.

He had no signs of emotional disturbance; he had no headache. He did not dream, and invariably replied "All reet" when asked how he felt. In about a month he recovered power over his bladder and the bowels opened naturally. Movements in arms and legs also increased, and he was able to sit on the edge of the bed and put his feet on the ground. Two months after admission he was able to stand and walk with the assistance of two men. The right hand grip was still weak but the left improved. Three months after admission he was able to walk with the aid of a stick and was sent to a convalescent hospital, where he made further progress.

There were no visible signs of injury in this case, but here we see that the whole wall of the dug-out was blown in and buried him; the force of the explosive was communicated to the spinal column by the solid earth. This man suffered spinal concussion

and shock; but the persistence of the plantar extensor response, ankle clonus and patellar clonus, and the loss of voluntary power pointed to damage of the upper motor neurones, and degeneration of the pyramidal tracts. The absence of sensory disturbance might be thought to be against microscopic hæmorrhages, such as have been found in the histological investigation. We know however by experiments on animals that the path for sensation is not localized in the same way as that for voluntary movement, and that hæmorrhages might occur at the base of the anterior horn destroying the terminal fibrils of the pyramidal tract fibres at their synapsis with the anterior horn cells without closing the sensory path. The shock effect would contribute largely to the loss of power of voluntary movement in the limbs, and the control of the bladder and bowel. The recovery which was made shows that shock, as well as organic changes in the spinal cord, was accountable for the symptoms.

The examination of the spinal cord of the fatal case described indicated to my mind that the lesions were not so severe and gross that he could not have recovered had it been possible to bring him to hospital sooner. His paraplegic condition, in my judgment, was largely due to commotional shock more than actual organic change. The microscopic changes discovered in the grey matter are the visible evidences of the severity of the shock to the spinal cord in its most sensitive and delicate structure, viz., the fibrillary synapses through which are transmitted volitional impulses and sensory impulses from superficial and deep structures.

The biochemical oxidation processes incidental to the transmission of nervous impulses from one system of neurones to another, take place at the synapses, possibly as Professor Marinesco suggests, under the influence of an oxidase ferment.

The intercalary neurones, second type of Golgi, whose axons never leave the grey matter, are always interposed between the neurones of the first type. Thus in the path of voluntary movement the axons of the psychomotor neurones of the motor area of the brain break up into a brush of fibrils at the base of the posterior horn where they are connected with intercalary neurones, which again are connected with the dendrons of the spinal motor neurones, the axis cylinders of which terminate in the voluntary muscles. We have seen that the most vulnerable part of the cord to commotion is the base of the posterior horn. At first there is a flaccid paralysis because the whole sensory reflex arc is knocked out; but as this shock effect passes off, the less vulnerable sensory

reflex path is again opened up, but the inhibitory influence of the more vulnerable psychomotor path on spinal reflex action having been lessened, if not abolished, the plantar reflex becomes extensor, ankle clonus is obtained and the deep reflexes are exaggerated.

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DESCRIPTION OF FIGURES.

FIG. 1.—Betz cells of leg area. There is commencing chromatolysis of varying degree. The Nissl granules are not so closely packed together as in normal cells. The nucleus is larger and clearer than normal. Magnification 350.

FIG. 2.—A small vessel cut longitudinally in the internal capsule. The vessel is filled with blood corpuscles; the perivascular sheath is seen dilated and filled with red blood corpuscles. Magnification 225.

FIG. 3.—Hæmorrhages into the white matter of the pons. Magnification 90.

FIG. 4.—Hæmorrhage into the sheath of a vessel in the median raphe of the medulla. Magnification 170.

FIG. 5.—Cells of the vago-accessorius nucleus at the level of the calamus scriptorius. Observe the marked chromatolysis and eccentric position of the nucleus. Compare the same with fig. 6. Magnification 400.

FIG. 6.—Cells of the adjacent hypoglossal nucleus, showing early slight chromatolysis. Magnification 400.

FIG. 7.—An arteriole breaking up into capillaries with dilated perivascular space. This space is in communication with the perineuronal space around the nerve cells. Magnification 300.

FIG. 8.—Section of cortex, Case 2. Dilated perivascular space around collapsed arteriole and capillaries. Dilated perineuronal spaces. Magnification 375.

FIG. 9.—Cortical cells from Case 2, showing swelling and chromatolysis of cytoplasm and clear swollen nuclei. Magnification 400.

FIG. 10.—Section of cerebellum, Case 1, stained with polychrome and eosin. Note the Purkinje cells are not all similarly stained. Two are stained faintly with the basic dye; the remaining ones are stained with the acid dye indicative of a chemical change. Magnification 270.

FIG. 11.—Medium sized anterior horn cells in first lumbar segment; a microscopic hæmorrhage is seen near, the Nissl granules have almost disappeared in the cells, and the staining is diffused and uniform without the displacement of the nucleus. Magnification 330.

FIG. 12.—Hæmorrhage, the size of a small pin's head, at the base of the posterior horn; the tissues around are fractured and retracted, but this may be in part due to the action of the fixing fluid. Magnification 185.

FIG. 13.—Two large anterior cornual cells from the third lumbar segment showing fairly well marked perivascular chromatolysis; the nucleus in one is eccentric and the nucleolus cannot be seen. Magnification 360.

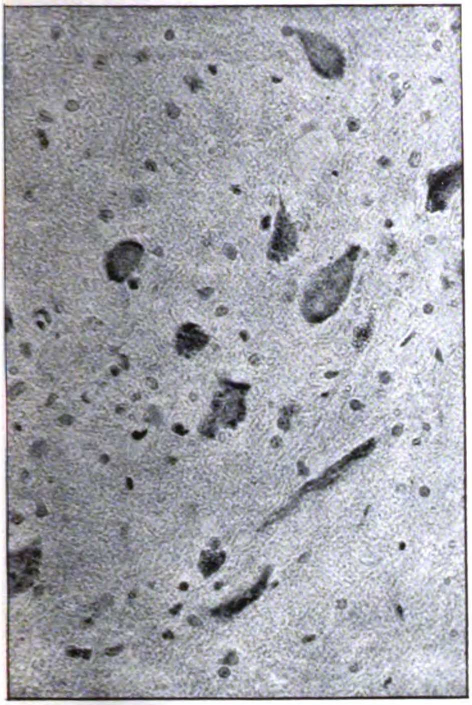


FIG. 5.

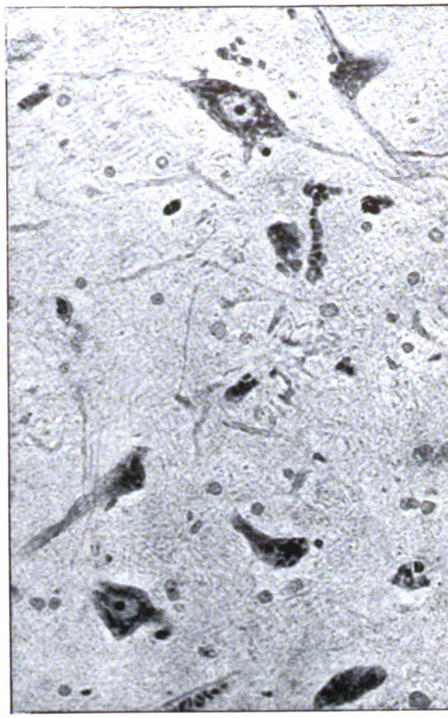
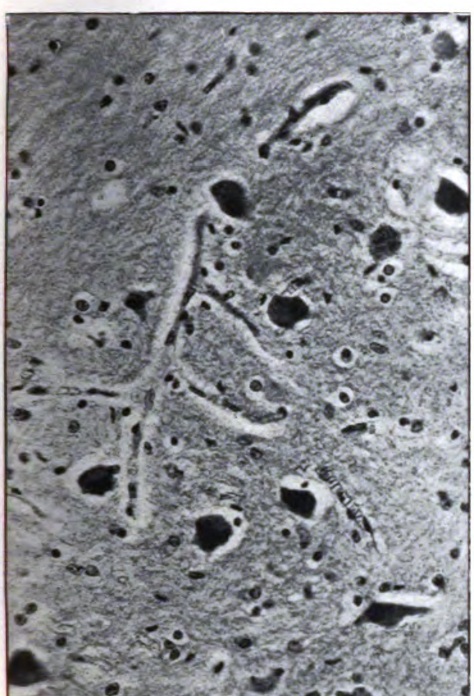


FIG. 6.



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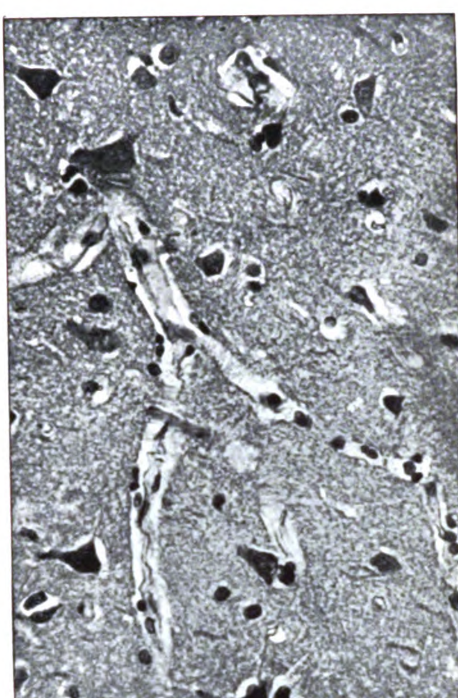


FIG. 8

To illustrate "The Microscopic Examination of the Brains of two men dead of Commotio Cerebri (Shell Shock) without visible external injury," by F. W. MOTT, M.D., LL.D., F.R.S., F.R.C.P., Major R.A.M.C.(T.).

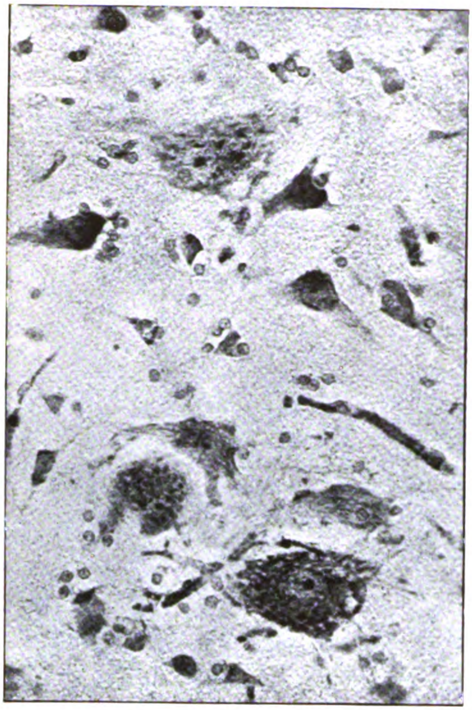


FIG. 1.

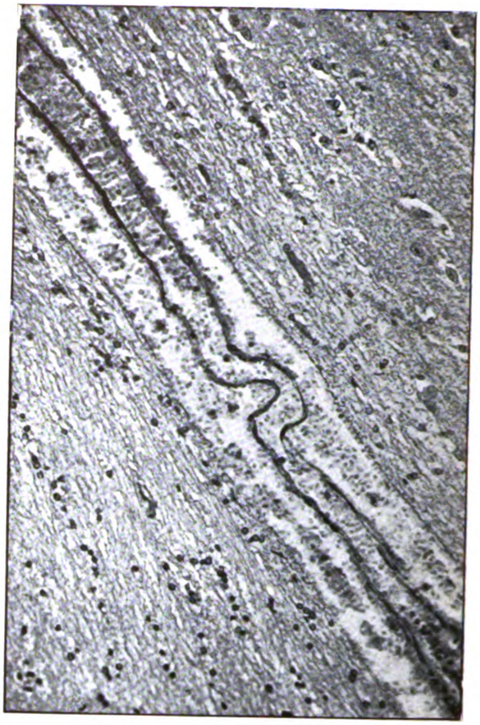


FIG. 2

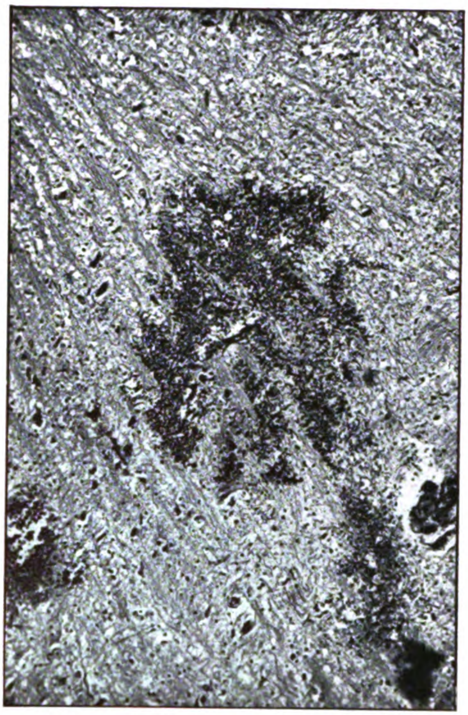


FIG. 3.

FIG. 4.

To illustrate "The Microscopic Examination of the Brains of two men dead of Commotio Cerebri (Shell Shock) without visible external injury," by F. W. MOTT, M.D., LL.D., F.R.S., F.R.C.P., Major R.A.M.C.(T.).

Fig. 9.

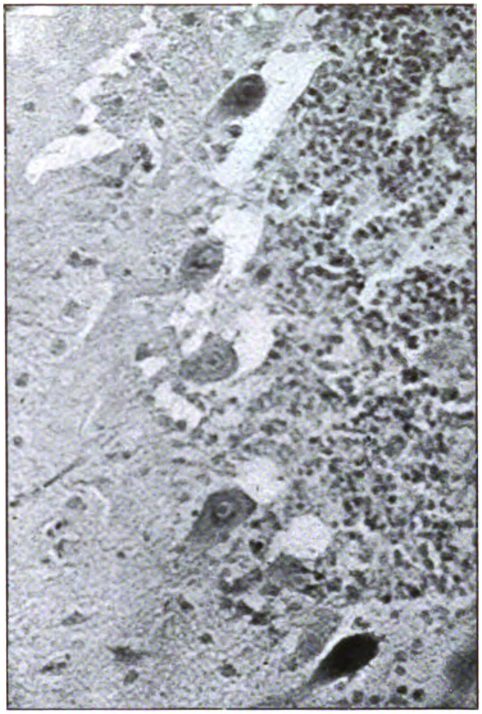


Fig. 10.

Fig. 11.

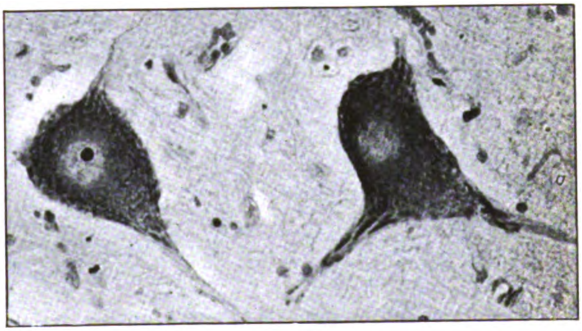


Fig. 12.

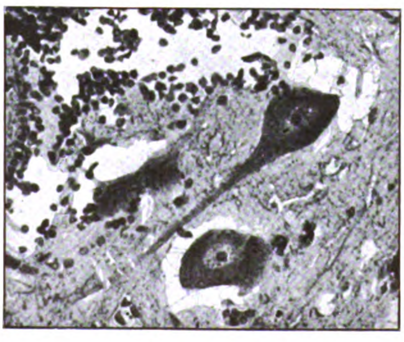


Fig. 13.

To illustrate "The Microscopic Examination of the Brains of two men dead of Commotio Cerebri (Shell Shock) without visible external injury" (Figs. 9 and 10), and "Commotion of the Spinal Cord" (Figs. 11, 12, 13), by F. W. Mott, M.D., LL.D., F.R.S., F.R.C.P., Major R.A.M.C.(T.).

REPORT UPON THE BACTERIOLOGICAL EXAMINATION OF ONE THOUSAND SOLDIERS CONVALESCENT FROM DISEASES OF THE DYSENTERY AND ENTERIC GROUPS.

By Captain WILLIAM FLETCHER,
Royal Army Medical Corps.

From the Laboratory of the University War Hospital, Southampton.

(*Continued from p.* 559.)

Prophylactic Inoculations and Agglutinin-Content of Serum in Carriers of B. paratyphosus A.—Five of the six carriers of *B. paratyphosus* A had been inoculated with a typhoid vaccine by the $\frac{\text{T.V.}}{2}$ method, and one (No. 656) with a mixed vaccine of typhoid and paratyphoid organisms, by the $\frac{\text{T.A.B.}}{2}$ system, four months before the onset of his illness. In four of the cases the blood-serum contained under fifty standard agglutinin units, per cubic centimetre, for *B. paratyphosus* A. The average for the six patients was thirty-nine, whereas the average number of standard agglutinin units in the blood of the carriers of *B. paratyphosus* B was found to be about ten times as great for that bacillus.

All the patients had been inoculated with a typhoid vaccine, and the blood-serum of all of them agglutinated that bacillus. The average number of standard agglutinin units for *B. typhosus* was twenty-seven.

Table showing Type of Prophylactic Inoculation and Agglutinin Content of Serum in Carriers of *B. paratyphosus* A.

Patient's laboratory number	Inoculations	Standard agglutinin units in 1 c.c.		
		Typhoid	Para A	Para B
197	T.V. 2	31	27	0
310	T.V. 2	12	61	0
666	T.V. 2	43	120	0
656	T.A.B. 2	22	5	20
782	T.V. 2	43	11	20
776	T.V. 2	22	11	0

In three cases the blood contained agglutinins for *B. paratyphosus* B, and in three it did not. In one of the former (No. 666), the presence of these agglutinins was accounted for by the patient being a carrier of *B. paratyphosus* B, in addition to *B. para-*

typhosus A; another (No. 656) had been inoculated by the $\frac{\text{T.A.B.}}{2}$ method; in the third case (No. 782) the reason was not determined. The preceding table shows the type of inoculation and number of standard agglutinin units in each case.

Cultural Reactions of Strains isolated.—The cultural reactions of the six strains isolated were all according to type. The organisms were motile, no indol was formed in peptone-water within fourteen days; milk was made acid, but was not clotted. Dulcite, glucose, maltose, mannite, and dextrin were fermented, with the production of acid and a bubble of gas.

Agglutinations of the Strains of B. paratyphosus A *isolated*.—Three of the strains (Nos. 197, 310, 666) were tested with a specific serum, obtained from the Lister Institute, which had a stated titre of 1/6,000. The first was agglutinated by the serum in a dilution of 1/6,000, the second at 1/10,000, and the third at 1/16,000. The other three strains (Nos. 656, 782, 776) were tested with Royal Army Medical College serum, A_2, which had a stated titre of 1/6,000. No. 656 was agglutinated at 1/1,280, No. 782 at 1/6,400, and No. 776 at 1/12,000.

Agglutinating Power of the Patients' Serum with the Paratyphoid Organisms isolated from their Excreta.—In every case the patient's serum agglutinated the paratyphoid organisms isolated from his excreta, but in no instance did it do so in high dilutions. In three cases (Nos. 197, 656, 776), there was no agglutination when the serum was diluted more than 1/20, and in none did it occur at a higher titre than 1/320.

Absorption Tests.—These were carried out as follows: Five agar slopes, twenty-four hours old, of each of the six strains under test, also of the type strain ("Schottmüller"), and of a *B. coli* culture, as a control, were emulsified in salt-solution, as follows: One cubic centimetre of salt-solution was added to a tube of each culture, and the growth emulsified. This emulsion was then pipetted into a second tube of the same culture, which was emulsified in the same fluid, and so on to the third. The resulting thick, creamy emulsion was then taken up in a pipette, and 0·8 cubic centimetre was added to a small tube containing 0·25 cubic centimetre of Royal Army Medical College serum A_2 (titre 1/6,000), diluted 1/20. The tubes were incubated at 37° C. for three hours. At the end of this time emulsions were made of the two remaining tubes of each culture, with a little more than 0·5 cubic centimetre of salt solution, and 0·45 cubic centimetre of each

emulsion was added to the corresponding tube of serum and bacilli, mixed three hours before. Altogether 1·25 cubic centimetres of an emulsion of each of the eight cultures was added, severally, to eight tubes, each containing 0·25 cubic centimetre of the specific serum, diluted 1/20, so that the dilution of the serum at this stage was 1/120. The tubes were then incubated for a second period of three hours, at the end of which time they were centrifuged, and the supernatant serum pipetted off. The agglutinating power of this serum was then tested, with equal quantities of emulsions of each of the eight cultures, i.e., in a final dilution of 1/240.

The results are set out below, in tabular form. It will be seen that the agglutinins for the type culture, and for each of the test cultures, were removed by all the organisms, except the control culture of *B. coli*.

SATURATION TESTS OF CULTURES OF *B. paratyphosus* A.

	Culture	Serum saturated with culture (1)	Do. (2)	Do. (3)	Do. (4)	Do. (5)	Do. (6)	Do. (7)	Do. (8)
(1)	Schottmüller ..	–	–	–	–	–	–	–	+
(2)	197	–	–	–	–	–	–	–	+
(3)	310	–	–	–	–	–	–	–	+
(4)	656	–	–	–	–	–	–	–	+
(5)	666	–	–	–	–	–	–	–	+
(6)	782	–	–	–	–	–	–	–	+
(7)	776	–	–	–	–	–	–	–	+
(8)	*B. coli*	–	–	–	–	–	–	–	+

Negative sign = no agglutination.
Positive sign = agglutination.

Carriers of B. paratyphosus B.

Thirty-five carriers of *B. paratyphosus* B were found among the patients convalescent from diseases of the dysentery and enteric groups (i.e., 3·5 per cent). Six of the thirty-five patients had been in the East, the remaining twenty-nine had come from France. Most of them were in early convalescence, and in only nine cases had more than twelve weeks elapsed since the commencement of their illness. The diagnoses on the transfer certificates of these thirty-five convalescents were as follows:—

17	.. Paratyphoid B	..	Nos. 135, 136, 143, 16, 282, 547, 588, 734, 666, 735, 999, 1,116, 1,118, 314, 521, 106, 581
1	.. Paratyphoid A	..	No. 511
1	.. "Paratyphoid"	..	No. 158
11	.. Dysentery..	..	Nos. 61, 518, 527, 551, 565, 1,081, 699, 702, 842, 886, 1,058
1	.. Typhoid ..	..	No. 360
3	.. "Enteric"	..	Nos. 73, 888, 1,107
1	.. "P.U.O."..	..	No. 548
35	Total		

The pathogenic organisms were discovered at the first examination in twenty-five cases; at the second in five; at the third in two, and during the incubation stage in three.

The patients are divided by the results of the examination of their excreta into four groups: (1) those from whose excreta paratyphoid bacilli were isolated on one or two occasions only; (2) those from whose excreta paratyphoid bacilli were repeatedly isolated, but disappeared during convalescence or soon after; (3) chronic carriers, including all cases from whom the organisms were isolated, frequently more than three months after the commencement of their illness; (4) precocious carriers, from whose fæces the infecting organisms were isolated during the stage of incubation.

Group (1): *Patients from whom excreta B. paratyphosus* B *was isolated on one or two occasions only.*—This group comprised 20 patients; in 16 of them *B. paratyphosus* B was isolated once only (Nos. 135, 73, 136, 159, 61, 143, 16, 282, 360, 511, 547, 548, 588, 734, 1116, 1118). In three of these cases (No. 54, 547, 548) the bacilli were recovered from the urine, in two during the fourth week after the onset of illness, and in one during the seventh week. In the thirteen cases remaining, the pathogenic organisms were found in the fæces. In every instance this was before the tenth week, except in one (No. 61) where they were isolated during the twentieth week, but not again in the course of four examinations made during a period of four weeks.

In eleven of the above sixteen cases, paratyphoid bacilli were isolated from the first specimen examined (Nos. 73, 159, 143, 360, 511, 547, 548, 588, 734, 1116, 1118); in three they were isolated during the examination of the second specimen (Nos. 135, 136, 282), and, in the two remaining cases, at the examination of the third.

The number of examinations made in the above cases was as follows:—

One patient (No. 159) was examined once, two (Nos. 282, 143)

were examined twice, and two (Nos. 16, 73) on three occasions. In these five cases, further specimens were not available, because the patients were transferred to other hospitals. The remaining nine cases were examined repeatedly during a period of four weeks after being found "positive"; the average number of examinations in each case being nine.

In four cases (Nos. 314, 518, 527, 588), *B. paratyphosus* B was recovered on two occasions only; in one instance it was found in the fæces (No. 314), and in three it was found in the urine (Nos. 518, 527, 888). Patient No. 314, the fæcal carrier, was examined twice, during the fifth week, with positive results on both occasions. He was then transferred elsewhere without further examination.

From the three urinary cases in which the bacillus was found on two occasions, it was isolated at the first and second examinations in two (Nos. 518, 527), and at the second and sixth in one (No. 888). These patients were subsequently examined during a period of four to eight weeks, and from ten to twenty examinations were made, in each case, with negative results.

The temperature of all the twenty patients included in Group (1), from whose excreta *B. paratyphosus* B was isolated on one or two occasions only, had fallen to normal before admission to this hospital. Most of them were in early convalescence from mild attacks, several having been up and walking about for more than a week. In short, Group (1) consisted of twenty patients from whose excreta the pathogenic bacilli were isolated at the end of a mild attack of paratyphoid fever.

Group (2): *Patients from whose excreta B. paratyphosus* B *was isolated repeatedly, but where the Bacilli subsequently disappeared.*—This group includes seven cases. In three of them *B. paratyphosus* B was recovered from the urine (Nos. 521, 551, 565), and in four from the fæces (Nos. 1081, 1107, 699, 702). Pathogenic bacilli were not found in the excreta of any of these cases later than the ninth week, except in one instance, patient No. 565, who was dangerously ill with subtertian malaria, and in whose urine *B. paratyphosus* B was present up to the fifteenth week.

These six cases will be considered briefly in detail.

(Ordinal numbers as applied to the weeks indicate the number of weeks which had elapsed since the commencement of the patient's illness).

No. 521. This patient was in a debilitated condition after a rather severe illness. *B. paratyphosus* B was isolated from the urine during the ninth week, on the first and three following

examinations. Fourteen subsequent examinations extending over a period of four weeks were negative.

No. 551. At the time of this patient's admission, five weeks after he was taken ill, he had a very slight relapse and *B. paratyphosus* B was found in the urine at the first three examinations. Ten subsequent examinations made during the next five weeks were all negative.

No. 565. When admitted to this hospital, in the tenth week, this patient was very anæmic, and he nearly died from an attack of subtertian malaria. Forty-seven examinations of his urine were made between December 5, 1916, and February 6, 1917. *B. paratyphosus* B was found at the first, fourth, seventh, tenth and fifteenth examinations on December 5, 14, 22, 29 and January 8, respectively. In this case the infection was probably prolonged by the debility and anæmia caused by the malaria.

No. 1081. This patient was also in a weak state when admitted in the sixth week. He had a history of a mixed infection of dysentery and enteric. Paratyphoid bacilli were recovered from his fæces at the first three examinations, fifteen subsequent examinations proved negative.

No. 1107. This patient was admitted with healing gunshot wounds of the shoulder and knee; he had an irregular temperature which had just come down to normal, after having been raised for two weeks. *B. paratyphosus* B was isolated from his fæces at the first and six subsequent examinations, the last occasion being in the sixth week.

No. 699. When in France, this patient had suffered from diarrhœa, and had passed blood and slime in his stools. His temperature was normal when he was admitted during the fourth week of his illness, and, on his papers, it was stated that it had never risen above normal. Like the other patients in this group, he was in a weak condition and unable to walk about. *B. paratyphosus* B was isolated at the first examination of his fæces, which was made the day after his admission, and in nine examinations out of thirty made subsequently. No paratyphoid bacilli were isolated after the seventh week.

No. 702. This patient had suffered from dysentery in France and he had still a little diarrhœa when he was admitted to this hospital, on January 8, in the middle of the third week. In this case, as in the last, it had been noted that the temperature did not rise above normal. Fifteen examinations of his fæces were made between January 10 and February 22. Paratyphoid bacilli were

found at the second and the six following examinations but not subsequently. This patient was suffering from a mixed infection; paratyphoid organisms and dysentery bacilli of the mannite fermenting group were present in his fæces together.

The cases in this group differ from those comprised in the first series, where the patients had just recovered from mild attacks. In this second group the patients had suffered from severe illnesses; all of them were "cot cases," and several of them were still ill when they were admitted to this hospital.

Group (3): *Patients who were chronic Carriers of B. paratyphosus* B.—This group comprises five patients (Nos. 106, 581, 666, 735, 999). Three of them (Nos. 106, 581, 666) had been in the Eastern Mediterranean. They were all fæcal carriers.

The term "chronic" is here applied to those cases who were still carriers after more than twelve weeks had elapsed since the commencement of their illness and from whose fæces the pathogenic organisms showed no tendency to disappear.

No. 106 was admitted to this hospital from the Mediterranean. He had a thrombosed vein in one leg, but was otherwise in good health. His excreta were examined six times with positive results upon each occasion, between the twentieth and twenty-second weeks, after which he was transferred elsewhere.

No. 681 was admitted, convalescent, at the beginning of the eighth week. His fæces were examined on forty-six occasions between December 8, 1916, and March 12, 1917, that is, up to the twenty-second week after the commencement of his illness. *B. paratyphosus* B was isolated at the first examination and on twenty-one subsequent occasions. He was in good health except for occasional attacks of diarrhœa. His fæces were not constantly "positive"; at times, no pathogenic bacilli were found for several days; then he would have a slight attack of diarrhœa and paratyphoid bacilli would become abundant in his fæces once more.

No. 666 was admitted to this hospital from the Eastern Mediterranean on December 22, 1916, in the seventeenth week after he was taken ill. Ninety-seven examinations of his fæces were made between January 2 and May 5 (thirty-five weeks after the beginning of his illness) and pathogenic bacilli were found on every occasion. This case will be more fully dealt with under the head of "Carriers of mixed infections," for, in addition to *B. paratyphosus* B, *B. paratyphosus* A was also constantly present. This patient was apparently in perfect health; he never suffered from fever, pains in the stomach, or looseness of the bowels; in fact, he seemed to be

quite immune to paratyphoid bacilli, which lead a purely saprophytic existence within him.

No. 735. This patient was taken ill in France, and admitted to this hospital in the seventh week, when his temperature was normal. A few days after his admission, he was up and walking about the hospital. Thirty-two examinations of his fæces were made between the seventh and fifteenth weeks and on each occasion *B. paratyphosus* B was present in large numbers. He was then transferred to another hospital. He appeared to be in good health and he said, himself, that he was as well as he had been before his illness.

No. 999 was taken ill on January 27; his temperature came down to normal on February 2. He was admitted to this hospital on March 12, in the seventh week, and he had a slight rise of temperature on the following day. Between March 13 and May 23, fifty-two examinations of his fæces were made, with positive results on each occasion. It is now sixteen weeks since the commencement of his illness and every sample of his fæces contains paratyphoid bacilli in large numbers.

Group (4): *Precocious Carriers.*—From time to time cases have been reported where the infecting organisms have been isolated during the incubation period of typhoid fever. While the evidence that such cases actually occur has been disputed by some, others have accepted it, and Sacquépée has classified such carriers as "*Porteurs précoces.*"

Three cases (Nos. 1058, 886 and 842) have been met with in this hospital where organisms of the "B" type have been isolated from the excreta during the incubation stage of paratyphoid fever.

These three men had been under observation for several weeks, during which their excreta were examined many times. They had all suffered from dysentery. From the stools of one (No. 1058) a mannite-fermenting dysentery organism was cultivated on several occasions; the second (No. 886) was a carrier of *B. dysenteriæ* of the Shiga type; the third (No. 842) suffered from chronic diarrhœa, the result of an old infection with Shiga's bacillus.

On April 13, 1917, *B. paratyphosus* B was isolated from the fourteenth specimen of the fæces of No. 1058. On April 14, the thirty-ninth sample of the fæces of No. 886 was examined and the same organism was isolated. On April 15, *B. paratyphosus* B was isolated from the ninth sample of the fæces of Case 842.

The following table shows the dates upon which specimens of the excreta of these men were examined, and the results :—

CASE 1058.

Date of sample	Result of examination	Date of sample	Result of examination
March 26 ..	+ (*B. dysenteriæ*)	April 21 ..	—
	(Mannite fermenting)	22 ..	—
28 ..	—	23 ..	—
30 ..	—	24 ..	—
31 ..	—	25 ..	—
April 2 ..	+ (*B. dysenteriæ*)	26 ..	—
3 ..	+ ,,	27 ..	—
4 ..	+ ,,	28 ..	—
5 ..	+ ,,	29 ..	—
7 ..	—	30 ..	+ (*B. paratyphosus* B)
9 ..	—	May 1 ..	+ ,,
10 ..	+ (*B. dysenteriæ*)	2 ..	—
11 ..	—	3 ..	+ (*B. paratyphosus* B)
12 ..	—	4 ..	+ ,,
13 ..	+ (*B. paratyphosus* B)	5 ..	+ ,,
14 ..	+ ,,	7 ..	—
16 ..	—	9 ..	+ (*B. paratyphosus* B)
17 ..	+ (*B. paratyphosus* B)	14 ..	+ ,,
18 ..	+ ,,		
19 ..	—	(No pathogenic organisms were recovered	
20 ..	+ (*B. paratyphosus* B)	in twelve subsequent examinations)	

CASE 886.

Date of sample	Result of examination	Date of sample	Result of examination
Feb. 23 ..	+ (*B. dysenteriæ*, Shiga)	April 21 ..	+ (*B. dysenteriæ*)
March 1 ..	—	22 ..	—
2 ..	—	23 ..	+ (*B. dysenteriæ*)
3 ..	—	24 ..	—
5 ..	—	25 ..	—
6 ..	+ (*B. dysenteriæ*)	26 ..	+ (*B. paratyphosus* B)
7 ..	—	27 ..	+ ,,
8 ..	—	28 ..	+ ,,
March 9	+ { (*B. dysenteriæ* con-	30 ..	+ ,,
to ..	stantly present ex-	May 1 ..	+ ,,
April 13	cept three occasions	2 ..	+ ,,
14 ..	+ { (*B. dysenteriæ* and	3 ..	—
	B. paratyphosus B)	4 ..	+ (*B. dysenteriæ*)
16 ..	+ { (*B. dysenteriæ* and	5 ..	—
	B. paratyphosus B)	6 ..	—
17 ..	+ (*B. dysenteriæ*)	7 ..	+ (*B. dysenteriæ*)
18 ..	+ (*B. paratyphosus* B)	8 ..	—
19 ..	+ (*B. dysenteriæ*)	9 ..	+ (*B. dysenteriæ*)
20 ..	+ ,,	(Transferred	to another hospital)

CASE 842.

Date of sample	Result of examination	Date of sample	Result of examination
Jan. 1 ..	—	April 21 ..	+ (*B. paratyphosus* B)
Feb. 2 ..	—	22 ..	+ ,,
28 ..	—	23 ..	+ ,,
March 2 ..	—	24 ..	+ ,,
3 ..	—	25 ..	+ ,,
13 ..	—	26 ..	—
14 ..	—	27 ..	+ (*B. paratyphosus* B)
15 ..	—	28 ..	+ ,,
16 ..	—	30 ..	+ ,,
17 ..	—	May 1 ..	+ ,,
20 ..	—	2 ..	+ ,,
21 ..	—	3 ..	+ ,,
22 ..	—	5 ..	+ ,,
April 15 ..	+ (*B. paratyphosus* B)	7 ..	+ ,,
16 ..	+ ,,	8 ..	+ ,,
18 ..	+ ,,	(No pathogenic organisms were isolated after May 10, in 20 subsequent examinations)	
19 ..	+ ,,		
20 ..	+ ,,		

(N.B.—In all the above tables a positive sign signifies the presence of pathogenic organisms in the samples. A negative sign indicates that no pathogenic organisms were isolated.)

When paratyphoid bacilli were first isolated from the fæces of these three men, they were all in their usual health and there was no change in their temperature or pulse-rate. Blood-cultures were made, with negative results in each case. The blood serum of none of them contained agglutinins for *B. paratyphosus* B, nor did it, in any instance, agglutinate the bacillus isolated from the fæces; later on, however, specific agglutinins developed in all the three cases.

To take the cases in more detail :—

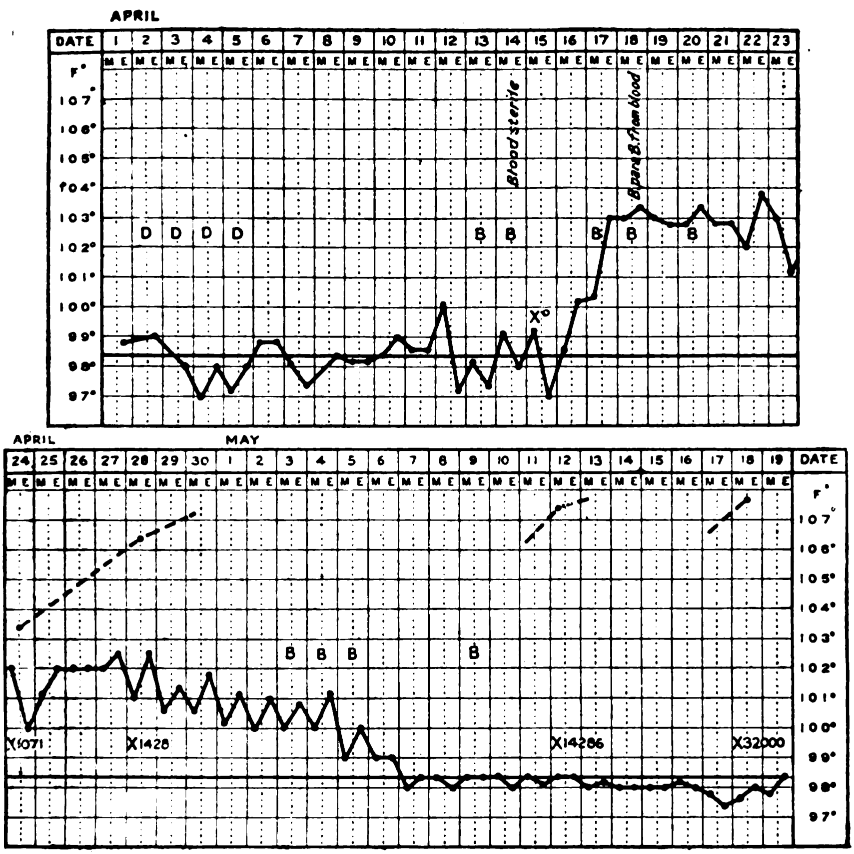
No. 1058, the first patient, was taken ill on the night of April 16, four days after the collection of the first specimen in which paratyphoid bacilli were found ; his temperature and pulse-rate then began to rise, and he entered upon a typical attack of paratyphoid fever. As mentioned above, when paratyphoid bacilli were first isolated from his fæces, no organisms were found in his blood, but on the second day of his illness another specimen was taken, and, on this occasion *B. paratyphosus* B was cultivated from it.

The curve of the agglutinin content of his serum followed the usual course; on April 15, three days after *B. paratyphosus* B was first isolated from his fæces, his blood contained no agglutinins for that bacillus. On April 24, which was the ninth day of his illness, it was found to contain no fewer than 1,071 standard agglutinin

units; on April 28 it contained 1,420 units; on May 5, 5,429 units, and on May 18, 32,000.

As shown in the accompanying table, *B. paratyphosus* B was repeatedly isolated from his excreta during the course of his illness up to the end of the fourth week, but not afterwards.

CHART OF PRECOCIOUS CARRIER. No. 1058.



D = *B. dysenteriæ* isolated from fæces. B = *B. paratyphosus* B isolated from fæces. X° = No agglutinins. X^{1071} = 1071 agglutinin units, etc. Dotted line = Curve of agglutinin content.

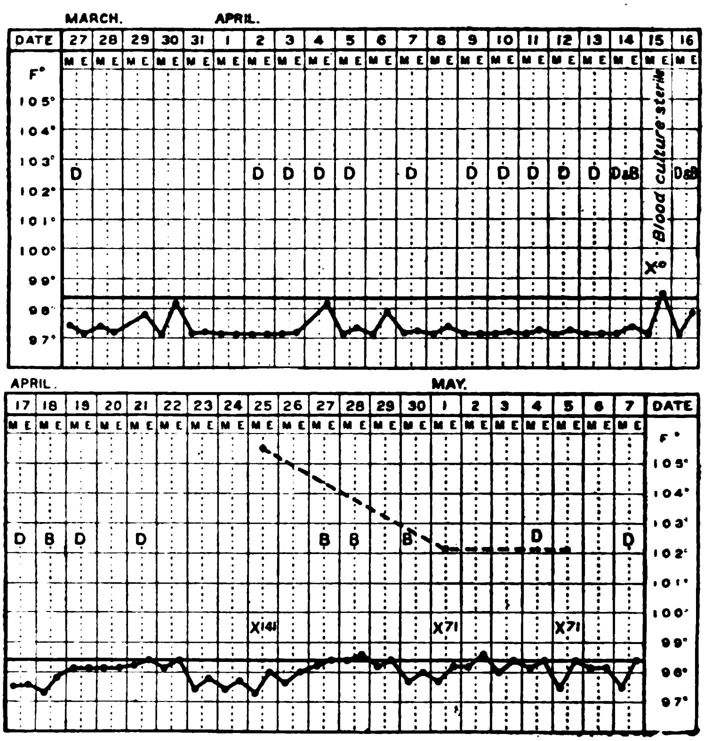
Case 886.—This patient was none the worse for his infection with paratyphoid; in fact, he declared that he was "better," and his weight increased by five pounds during the first week.

When *B. paratyphosus* B was first isolated from his fæces, his

blood contained no paratyphoid agglutinins. Their subsequent appearance shows that a general infection occurred, though, for all practical purposes, this patient was a healthy carrier.

B. paratyphosus B was first isolated from his fæces on April 14. His blood was examined on the following day and was found to contain no agglutinins for a standard emulsion of *B. paratyphosus* B or for an emulsion of the bacillus isolated from his fæces. Blood cultures remained sterile. Ten days later, on April 25, his blood contained 141 paratyphoid agglutinin units: on May 1 this number had declined to seventy-one, and on May 5 it had not altered. He was, then, transferred to another hospital.

CHART OF PRECOCIOUS CARRIER. No. 886.

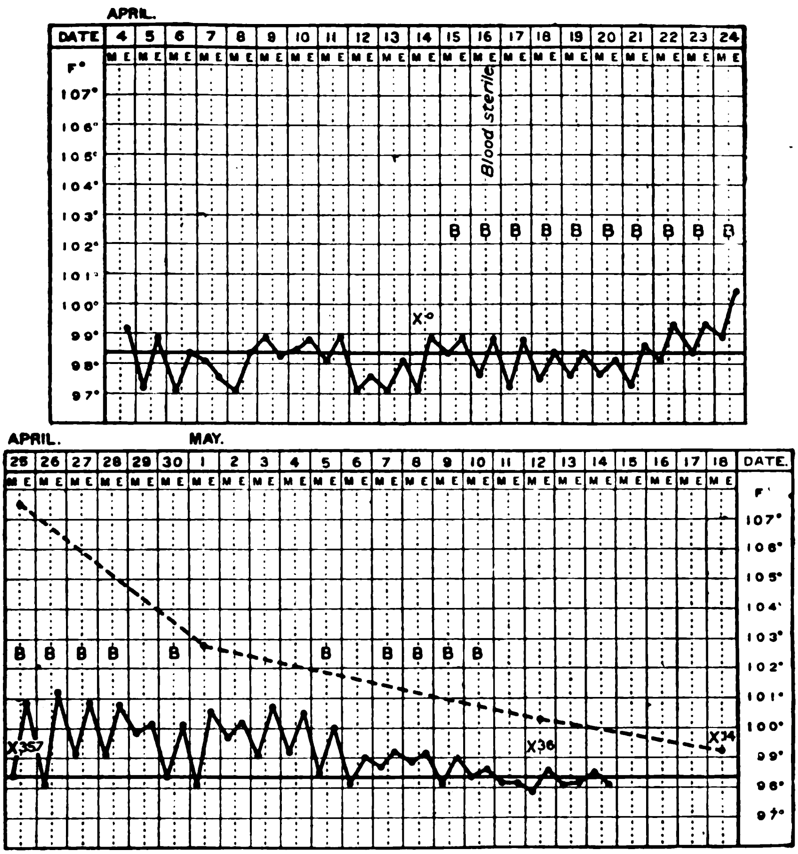


D = *B. dysenteriæ* isolated from fæces; B = *B. paratyphosus* B isolated from fæces; X° = No agglutinins; X[71] = 71 agglutinin units, etc.; Dotted line = Curve of agglutinin content.

Case 842.—The third patient had been ill for many months, suffering from "colitis" which had followed an attack of dysentery. He had been under treatment here since the beginning of the year

when, on April 15, *B. paratyphosus* B was isolated from his fæces. At that time he was in better health than usual. His blood serum contained no paratyphoid agglutinins nor could paratyphoid bacilli be cultivated from it. He remained in the same condition, eating well, sleeping well and getting up a little every day, until April 24, nine days later, when his temperature, which often rose to 99° F. in the evening, went up to 100·5° F. and a mild attack of paratyphoid fever commenced.

CHART OF PRECOCIOUS CARRIER. No. 842.



B = *B. paratyphosus* B isolated from fæces. X^{0} = No agglutinins.
X^{357} = 357 agglutinin units, etc. Dotted line = Curve of agglutinin content.

On April 14, there were no paratyphoid agglutinins in his serum. On April 25 it contained 357 units; on May 1, 71 units, and on May 18, 14 units. Between April 15 and May 10 *B. para-*

typhosus B was isolated from nineteen samples of his fæces, but the organism was not found again in a large number of examinations made subsequently.

It was established, without a doubt, that these three men had become infected by a chronic carrier of *B. paratyphosus* B with whom they had come in contact.

The cultural reactions, of the three strains isolated, were according to type. They were all agglutinated by a specific serum in dilutions as high as 1/10,000 (the serum employed was Royal Army Medical College B_2 titre 1/10,000) and all three strains absorbed the specific agglutinins from that serum.

The results of the investigation of these cases show clearly that people in the incubation stage of paratyphoid fever may be carriers of infection. It is only by an accident that such persons come to be examined, so that they are but rarely detected. It may be that it is the rule, and not the exception, for persons in the incubation stage of fevers of the enteric group to be carriers of the pathogenic organisms which have multiplied in their intestine and are being passed in their excreta.

Prophylactic Inoculations and Agglutinin Content of Serum in Carriers of B. paratyphosus B.—In thirteen of the thirty-five cases from which *B. paratyphosus* B was isolated, there was documentary evidence of the men having received prophylactic inoculations of a mixed typhoid and paratyphoid vaccine. In one case (No. 518) the inoculation was given only two weeks before the onset of illness, and in four other cases within two months of the attack (125, 136, 16, 551). The other eight cases had been inoculated within a year of their illness.

None of the patients in the third group (which comprised the five chronic carriers) had been inoculated with a paratyphoid vaccine.

The blood of three of the patients (73, 61, 360) in Group (1), from whose fæces *B. paratyphosus* was isolated once only, contained no agglutinins for that bacillus.

In Group (2) and Group (3) the serum of all the patients agglutinated *B. paratyphosus* B except that of No. 565, from whose urine the bacillus was isolated five times in five weeks. He was very ill and very anæmic from subtertian malaria when his blood was taken for examination, and this may account for the absence of agglutinins.

The serum of the "precocious carriers" in Group 4 when first examined contained no paratyphoid agglutinins, but, as already mentioned, they developed later. The figures in the table give the

results of the examinations made when *B. paratyphosus* B was first discovered in the excreta of these men.

TABLE SHOWING TYPE OF PROPHYLACTIC INOCULATIONS AND AGGLUTININ CONTENT IN CARRIERS OF PARATYPHOID B.

Number		Inoculation	Standard Agglutinin Units		
			Typhoid	Para A	Para B
Group I. (Convalescent from mild attacks)	135	T.A.B. 2 (7 weeks before)	1,250	108	1,000
	73	T.V. 1	62	0	0
	136	T.A.B. 1 (6 weeks before)	62	54	96
	159	T.V. 2	62	0	96
	61	T.V. 2	62	0	0
	143	T.V. 1	62	0	96
	16	T.A.B. 1 (8 weeks before)	62	30	32
	282	T.V. 1	125	0	96
	360	T.V. 1	39	0	0
	511	T.A.B. 2 (6 weeks before)	40	13	7
	547	0	9	8	14
	548	T.A.B. 2 (9 months before)	86	36	676
	588	T.V. 2	43	7	100
	734	T.V. 2	431	0	200
	314	T.V. 2	12	0	960
	518	T.A.B. 2 (2 weeks before)	100	18	20
	527	T.A.B. 2 (9 months before)	21	13	14
	888	T.V. 2	8	0	14
	1,116	T.A.B. 2 (10 months before)	4	0	286
	1,118	T.A.B. 2 (2 months before)	208	11	357
Group II. (Convalescent from more severe attacks)	1,107	T.V. 2	34,000	0	57,155
	521	T.V. 2	17,655	0	60,234
	551	T.A.B. 2 (8 weeks before)	43	7	8
	1,081	T.A.B. 1 (8 months before, Own statement)	42	27	714
	565	T.V. 2	86	0	0
	699	T.A.B. 2 (10 months before)	9	0	20
	702	T.V. 2	27	0	36
Group III. (Chronic carriers)	106	T.V. 2	622	0	200
	581	T.V. 2	9	0	320
	666	T.V. 2	43	120	20
	735	T.V. 2	86	0	500
	999	T.V. 2	532	0	714
Group IV. (Precocious carriers)	842	T.V. 2	42	0	0
	886	T.V. 2	4	0	0
	1,058	T.A.B. 2 (5 months before)	8	0	0

The above table shows the type of prophylactic inoculations and the number of standard agglutinin units for typhoid and paratyphoid emulsions in the serums of the thirty-five carriers of *B. paratyphosus* B.

In some of the earlier cases, the agglutinations were not carried beyond a dilution of 1/250.

(*To be continued.*)

THE TREATMENT OF CHLORINE GAS POISONING.

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From the attacks on April 27 and 29, 1916, in front of Hulluch, I had the opportunity of treating a number of cases of acute poisoning by chlorine gas. These cases arrived fourteen hours after being gassed. The weather conditions were good, and the following is an account of the treatment adopted:—

Methods and Effects of Treatment.

Slight Cases.—The routine treatment for slight cases was as follows:—

(1) Ammonia capsule.

(2) Atropine $\frac{1}{50}$ grain hypodermically, if not already administered.

(3) Fluid diet or light diet for twenty-four hours.

(4) Open air in a marquee during the day to ensure constant change of air.

(5) An expectant mixture of ammonia carbonate on the second day.

(6) Evacuation to base on third day if condition admits.

Serious Cases.—No routine treatment can be adopted for the severe cases because the nature of one case differs from that of another, and a different treatment has to be adopted. I divided these cases into two groups: the "pulmonary" and the "cardiac failures," because each of these groups demands a separate line of treatment.

Treatment of Pulmonary Cases.—By these I mean cases coming in deeply cyanosed, chests full of râles, in great distress, and dyspnœa. After the administration of ammonia and atropine, venesection was done to the amount of fifteen to twenty-five ounces. After forty-eight hours these cases were given light diet and an expectorant mixture of ammonia carbonate and detained in hospital to time of writing. These cases if venesected on admission do well. Oxygen to this class of case is beneficial and especially so if given in concentrated amounts through a rubber mouthpiece, a gas-bag and two-way valve. The mere administration of oxygen by means of a funnel held near the face is wasteful and of little good.

Cardiac Failure Cases.—A case admitted pallid instead of cyanosed, chest not bubbling with fluid, and a feeble pulse. These cases may be mistaken for lighter cases because there is no marked distress, but they are even more serious than the cyanotic type because they have a sudden collapse.

The following example illustrates the fact:—

Pte. F., aged 28. Admitted April 30. On admission he was not distressed, not cyanosed, and was placed with the slighter cases. The next morning at 12 he collapsed suddenly, his pulse became feeble, and he died at 3.20 p.m., the same afternoon, in spite of stimulants.

Venesection does no good in these cases because the heart is not engorged, and there is no great increased resistance through the lungs. Stimulants to these cases are indicated, and strychnine, digitalin and pituitrin have been given with good results.

Effects of Treatment.

(1) *Ammonia capsules* stimulate respiration and in many cases lessen the cyanosis. The patients ask for them.

(2) *Atropine $\frac{1}{50}$ grain.*—This is given as a routine, but I have had no definite proof that it has a good result. It certainly cannot have any appreciable effect upon the amount of fluid in the lungs, but it may tend to lessen bronchial spasm, because there have been no cases of the latter. In no case was any cardiac collapse brought about by its administration.

(3) *Venesection.*—The effect of venesection is, I think, striking. It has been done on forty-two recorded cases, all serious, of which twelve died, and thirty-two are still alive.

It seems to have the following effects:—

(i) Relieves cyanosis greatly.

(ii) Relieves congestion in the lungs, enabling the patients to breathe more easily.

(iii) Relieves the acute headache which patients are subjected to after twenty-four hours of the gas poisoning.

(iv) Promotes sleep by the physical withdrawal of blood from the system, and a patient wakes refreshed and less distressed than before.

Early venesection is necessary, as is shown in the following example:—

Ten cases were cyanosed and equally distressed. Five were venesected and did well with no further treatment. Of the remaining five two died within twelve hours and three became livid and

more distressed within twelve hours, and venesection was done then. These three required cardiac stimulants after bleeding. The longer the heart has to work against an increased peripheral resistance the weaker it becomes and, by bleeding early, the resistance is lowered and the heart is not put to so great a work.

The following are notes of the first thirty cases upon which venesection was tried :—

(1) Pte. C., aged 22. Admitted very cyanosed and distressed. Oxygen administered. Bled fifteen ounces. Colour improves. Pulse becomes slower and patient sleeps six hours.

(2) Pte. McF., aged 28. Admitted cyanosed. Pulse rapid. Bled twenty ounces. Says, "Relieved chest, which was fairly choked, and made me sleep well." Colour improved and remained good.

(3) Lance-Cpl. McG., aged 32. Admitted cyanosed. Venesection done under oxygen. Bled twenty ounces. Says, "Felt chest relieved and made me sleep." Colour improved slowly and good progress.

(4) Pte. C., aged 40. Admitted April 29. Became cyanosed on May 1. Bled twenty-five ounces on account of plethoric and alcoholic type. Says, "Stopped me breathing so quickly and made me sleep." Colour remained good.

(5) Pte. D., aged 31. Admitted delirious and restless. Very cyanosed. Bled twenty ounces. Says, "Relieved pains in head, eased breathing, and made me sleep." Colour improved.

(6) Serjt. F., aged 38. Admitted cyanosed and unconscious. Bled twenty ounces. Says, "Felt grand, relieved headache and eyes and slept whole afternoon after it." Colour remains good.

(7) Serjt. McC., aged 47. Admitted cyanosed, delirious and collapsed. Bled fifteen ounces. Says, "It did good to breathing and relieved pain in head." Colour remains good and pulse slower.

(8) Lance-Cpl. L., aged 23. Admitted unconscious and cyanosed. Pulse feeble, given strychnine. Pulse improved next day and bled twenty ounces. Says, "Helped well, slept well after it and relieved pains in head."

(9) Pte. H., aged 37. Admitted cyanosed, dyspnœa and delirious. Bled twenty ounces. Says, "Felt improved, lighter in head and relieved tightening in chest." Colour remains good.

(10) Lance-Cpl. G., aged 31. Admitted very cyanosed and dyspnœic. Bled twenty-five ounces. Says, "Cut did good. Relieved pain in head, made breathing easier, and made me sleep." Colour remains good.

These are ten out of the first thirty upon whom venesection was done and all ten lived. Those who died were moribund on admission. All cases bled early, did well, but those bled later required cardiac stimulants. In all cases the respiration and pulse rates were lowered, the colour improved, and sleep was induced, and I began to rely on venesection as a routine for the cyanotic group of patients.

(4) *Expectorants.*—I tried ammonia carbonate and ipecacuanha separately. Twelve men put on ammonia carbonate had copious frothy sputum on the third day and the chests cleared up. If ammonia carbonate is given before the end of forty-eight hours too great irritation results.

Twelve men put on ipecacuanha, thirty minims of the vinum every two hours, had very little cough, very little sputum and that of a viscid nature, but their chests cleared up equally well. Ipecacuanha was not given in sufficient amounts to promote vomiting, but it seems to have absorbed moisture from the tissues, which have replaced it from that in the lungs, and thus dried up the lung condition equally well as when ammonia carbonate had been administered.

(5) *Hypnotics.*—Morphia was given in two different classes of cases:—

(*a*) For the pleuritic pain at the costal margin, caused by the emphysematous condition of the margin of the lung underneath. This begins on the third day and morphia is the only method of relief when applications of iodine, mustard leaves and fomentations have failed.

(*b*) To promote rest: the following is an instance:—

Pte. L., aged 21. Admitted very cyanosed and delirious. Very feeble pulse and chest very congested. No venesection was done on account of the pulse; twenty-four hours after admission he was worse, more cyanosed, delirious, and very restless. He was weakening with his restless movements. Morphia $\frac{1}{4}$ grain was given, although every condition contra-indicated it. He slept twelve hours, became less cyanosed, quiet and pulse greatly improved. He has made steady progress since, i.e., four days later. In this case morphia undoubtedly saved his life, but except for specially selected cases, it is not a routine line of treatment.

(6) *Postural Treatment.*—This is of value in those cases whose condition is so severe that the reflex of coughing is abolished. If a patient is conscious, lying on his side with the lower end of the bed raised a foot encourages the secretion in his lungs to flow towards

the mouth, when it can then be expectorated. If a patient is unconscious, lying flat on his back with the foot of the bed raised two feet leads to the mechanical trickling down of the pulmonary secretion into the throat, when it can be swabbed out at regular intervals.

Example.—Lance-Cpl. C., aged 38. Admitted very cyanosed and distressed. Unconscious. His chest was congested. Had been bled at the field ambulance, but venesection was done again; twenty ounces were removed. His cyanosis improved, but his chest symptoms remained as coughing was abolished. Foot of bed raised two feet. Oxygen given under pressure and pituitrin. Although still unconscious, a great deal of fluid trickled into his mouth till he frothed. This fluid has been swabbed out at intervals (regularly), and now the patient is in a much better condition than on admission, although still unconscious.

(7) *Emphysema.*—Pulmonary emphysema leads to agonizing pains. These begin on the third day, as a rule, occurring where the lung is unprotected, i.e., along the edges of the lung at the costal margin, and causes great pain of a pleuritic nature over the lower ribs in front. Painting with strong iodine and morphia when it can be given in safety is effective.

Surgical emphysema was found in four cases, and usually requires no treatment, but the following case was exceptional:—

Cpl. D., aged 22. Admitted April 27. Very distressed and cyanosed. His chest was not so very congested as to account for the cyanosis, and his pulse was good. At the root of the neck in front he had a soft round diffuse swelling at each side, extending over his clavicles in front to a couple of inches over his pectoral muscles, and behind it extended to the trapezius muscle, and above to the angle of the jaw. Breath sounds could be heard over the swelling with a stethoscope. On palpation it felt soft, crepitant, and became tense at each inspiration, worse so on coughing. The cyanosis was caused by pressure from it on to the trachea. A large pad of wool was strapped tightly down on to the side of the neck and clavicles, enabling the patient to breathe and cough without increasing the pressure on the trachea. In twenty-four hours his colour improved, breathing was easier, and he has made a good recovery.

(8) *Mouth Condition.*—On the second day patients' mouths became covered with a very viscid, foul, and green mucous, causing much discomfort. Repeated swabbing with hydrogen peroxide clears this condition up in twenty-four hours, and carbolic and glycerine mouth-washes further improve it.

(9) *Lactate of Soda.*—On May 1 ten patients were selected of equally increased respirations, and equally serious, as far as could be judged. The five odd numbers were put on lactate of soda (fifty per cent), and the five even numbers were put on no treatment.

Respirations were counted at regular intervals:—

	May 1 Times					May 2 Times						May 3 Times						May 4 Times	
	A.M.		P.M.			A.M.			P.M.			A.M.			P.M.			A.M.	
	12.30	3	6	8	12	6	10	4	6	8	10	12	6	12	4	8	12	4	6
Mc.	52	56	52	46	48	43	34	32	32	37	34	36	33	38	42	40	39	36	34
T.	58	56	44	42	48	Died													
E.	40	44	40	35	36	36	30	28	28	38	36	37	38	28	26	30	30	28	25
O.	56	52	48	51	52	44	48	56	Died										
F.	60	56	44	52	48	47	42	38	34	38	35	39	38	40	60	49	51	52	44
M.	42	36	32	28	34	29	30	32	40	34	36	33	20	24	28	26	25	25	20
B.	52	44	48	48	48	35	30	30	38	44	46	47	36	34	36	38	36	36	32
S.	40	46	44	40	48	44	36	38	36	38	36	34	31	29	30	34	32	31	29
R.	44	48	52	54	48	34	38	34	34	34	36	40	38	34	30	35	35	42	43
B.	52	48	54	39	40	33	34	44	44	46	36	38	34	32	30	32	27	31	32
Lactate soda given—	1 p.m.			7 p.m.				2 p.m.	7 p.m.					10 a.m.				6 p.m.	

Mc. Doing well.
T. Died from cardiac failure and not pulmonary inflammation.
E. Doing well.
O. Died from cardiac failure (chronic heart disease at post mortem).
F. Did well at first, but on third day became worse, distressed, due to pleuritic pains in chest due to emphysema.
H. Doing well.
B. Doing well.
S. Doing well.
R. Did well until one day ago, when he began to get distressed from pleuritic pains.
B. Doing well.

From the trial on these ten cases I do not think a definite conclusion can be drawn, because it is difficult to pick out and compare two cases of exactly equal conditions, and with the exception of T. and O. the patients with no lactate of soda are as well as those who had it.

Post-mortem.—There was generally marked cyanosis. Rigor mortis was always well marked. There were no petechial hæmorrhages. The venous system was engorged. With the exception of one case, there was no fluid in the pleural cavity. In this case there was a good deal of serous fluid in both pleural sacs. The lungs were smaller, and did not show either the extensive emphysema or the œdema noted in the cyanotic type of case.

The lungs were enlarged and very markedly emphysematous, especially at the margins. The heart was slightly enlarged, the left ventricle full of dark clot, the right ventricle less full, and the pulmonary artery contained a dark blood-clot in each case.

Death was due to acute congestion of the lungs and subsequent heart failure.

Clinical and other Notes.

A REPORT ON THE TREATMENT OF *ENTAMŒBA HISTOLYTICA* "CARRIERS" WITH EMETINE BISMUTH IODIDE, GIVING A COMPARISON BETWEEN THE KERATIN-COATED TABLOIDS AND SALOL-COATED PILLS.

By D. G. LILLIE, M.A.Cantab.
(*Late Biologist to the British Antarctic Expedition*, 1910.)
AND
Captain S. SHEPHEARD.
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A Report to the Medical Research Committee, from the Mont Dore Military Hospital, Bournemouth.

The treatment of the 104 cases dealt with in this report was carried out in a special ward set apart for the purpose.

The cases were under the care of one medical officer in order to keep the conditions of treatment as uniform as possible.

Both forms of the drug were given in doses of three grains per day for twelve consecutive days, without any additional treatment.

The tabloids and pills were given entire, as a full dose during breakfast.

We have considered a case to be cured when he has had at least six or seven negative tests over a period of not less than seven weeks from the termination of his course of treatment. The last one or two tests were made at the Barton Convalescent Depot. The great majority of the cases, however, had many more tests: some were examined almost daily and were under observation for nearly three months after the end of treatment.

First Course of Treatment.

The number of men treated with one course of the keratin-coated tabloids supplied by Burroughs Wellcome and Co. was seventy-nine, and the number of men who were given one course of salol-coated pills prepared by Allen and Hanburys was twenty-five.

We have found it advisable to divide these two sets of men into those who had injections of emetine hydrochloride before entering hospital and those who did not receive this treatment.

The results are as follows:—

Cases without Emetine Injections.—Forty-five men were given one course of the keratin-coated tabloids and twenty-nine were cured, i.e., 64·5 per cent.

Seventeen men were given one course of the salol-coated pills and twelve men were cured, i.e., seventy per cent.

Cases with Emetine Injections.—Thirty-four men were given one course of the keratin-coated tabloids and twelve were cured, i.e., thirty-five per cent.

Eight men were given one course of the salol-coated pills and five were cured, i.e., sixty-two per cent.

SECOND COURSE OF TREATMENT.

Twenty-four men who had relapsed after one course of the keratin-coated tabloids were given a second course of the same form of the drug and four were cured, i.e., 16·6 per cent.

Fourteen men who had relapsed after two or three courses of the keratin-coated tabloids were treated with one course of the salol-coated pills and four were cured, i.e., 28·5 per cent.

EFFECT OF THE TIME INTERVAL BETWEEN THE ONSET OF DISEASE AND TREATMENT.

The object of this part of the inquiry was to ascertain whether those cases which relapsed after treatment could be shown to be "carriers" of longer standing, in whom *E. histolytica* had become better established and consequently harder to cure. In order to make certain, as far as possible, that the onset of the disease referred to was that of amœbic dysentery, only those patients were included under this section whose blood failed to agglutinate *B. dysenteriæ* Shiga and *B. dysenteriæ* Flexner.

Cases without Emetine Injections.—Out of nineteen men who were cured by emetine bismuth iodide seven (36·8 per cent) had an interval of over twenty weeks between the date of onset of their dysentery symptoms and the date on which they received emetine bismuth iodide treatment. The average interval for the nineteen cases was nineteen weeks.

Out of fourteen men who relapsed after treatment with emetine bismuth iodide eight (50·7 per cent) had an interval of over twenty weeks between the date of onset and treatment. The average interval for the fourteen cases was twenty-two weeks.

Cases with Emetine Injections.—Out of twelve men who were cured by emetine bismuth iodide treatment ten (80·3 per cent) had an interval of over twenty weeks between dates of onset and treatment. The average interval for the twelve cases was twenty-nine weeks.

Out of fourteen men who relapsed after treatment with emetine bismuth iodide eleven (78·5 per cent) had an interval of over twenty weeks between the dates of onset and treatment. The average interval of the fourteen cases was forty-two weeks.

VOMITING.

Out of forty-six cases cured by the keratin-coated tabloids forty vomited during treatment, i.e., eighty-seven per cent.

The total number of days on which the forty vomited was 285. The

average number of vomiting days for those men who vomited gives a convenient co-efficient for purposes of comparison, i.e., seven.

Out of twenty-one cases cured by the salol pills fourteen vomited during treatment, i.e., sixty-six per cent.

The fourteen who vomited had fifty-three vomiting days, i.e., vomiting co-efficient 3·7.

Out of forty-five cases who relapsed after the keratin-coated tabloids, thirty-seven vomited during treatment, i.e., eighty-two per cent.

The thirty-seven who vomited had 333 vomiting days, i.e., vomiting co-efficient 9.

Out of eighteen cases who relapsed after the salol-coated pills, fourteen vomited during treatment, i.e., seventy-eight per cent.

The fourteen who vomited had sixty-three vomiting days, i.e., vomiting co-efficient 4·5.

Loss of Weight.

Out of forty-six men cured by keratin-coated tabloids twenty-four lost weight, i.e., fifty-two per cent.

Out of twenty-one men cured by salol-coated pills seven lost weight, i.e., thirty-three per cent.

Out of forty-five men who relapsed after keratin-coated tabloids eighteen lost weight, i.e., forty per cent.

Out of ten cases who relapsed after salol-coated pills five lost weight, i.e., fifty per cent.

Effect of Age on Curative Results.

The average age of thirty-eight cases cured by keratin-coated tabloids was 27·6 years.

Eleven men out of the thirty-eight were over thirty years of age.

The average of thirty-eight cases which relapsed after keratin-coated tabloids was 28·9 years.

Eleven men out of the thirty-eight were over thirty years of age.

The average age of seventeen cases cured by salol-coated pills was 28·7 years.

Four of the seventeen were over thirty years of age.

The average age of seventeen cases which relapsed after salol-coated pills was 28·4.

Five of the seventeen were over thirty years of age.

Effect of Age on Vomiting.

Thirty-six men under twenty-five years treated with keratin-coated tabloids had 271 vomiting days, i.e., vomiting co-efficient 7·5.

Twenty-six men over thirty years treated with the same tabloids had 157 vomiting days, i.e., vomiting co-efficient six.

Seven men over forty years treated with the same tabloids had twenty-two vomiting days, i.e., vomiting co-efficient 3·1.

Conclusions.

The conclusions which we think may be drawn from the foregoing facts are as follows:—

(1) (*a*) That "carriers" of *E. histolytica* who had not had any injections of emetine hydrochloride were cured to the extent of seventy-eight per cent by two courses of the salol-coated emetine bismuth iodide pills. (*b*) In the case of men who had had emetine injections 72·8 per cent were cured by two courses of the salol-coated pills. (*c*) In the case of men who had not had emetine injections seventy per cent were cured by two courses of the keratin-coated tabloids. (*d*) In the case of men who had had emetine injections 45·4 per cent were cured by two courses of the keratin-coated tabloids.

The difference between the percentages in (*a*) and (*b*) are within the range of experimental error and need not be considered. But in (*c*) and (*d*) the difference is too great to be ignored.

This difference may be due to variation in the quality of the keratin-coated tabloids, but such a defect would be common to both cases which had received injections of emetine and those which had not.

It is generally admitted that certain "carriers" of *E. histolytica* are not cured by emetine in any form and it may be, as Mr. Dobell suggests, that these cases became segregated in (*d*). It seems possible that the difference on the two percentages may be due to the injections of emetine rendering the "carriers" less liable to be cured by emetine bismuth iodide.

For comparisons with the above percentages of cures by a maximum of seventy-two grains of emetine bismuth iodide carried out in the special ward, we give the number and percentage of cures in the other wards of this hospital.

The number of grains of emetine bismuth iodide which these cases received varied from 36 to 200. A case was regarded as cured after not less than five negative examinations over a period of not less than five weeks after the end of treatment. The last test was made at the Barton Convalescent Depot. Out of 160 cases treated 142 were cured, i.e., 88·7 per cent.

(2) There is no evidence that the length of time between the dates of onset of dysentery symptoms and the treatment has any effect upon the chances of cure by emetine bismuth iodide.

(3) There is no ground for the belief that the vomiting diminishes the chances of cure by the emetine bismuth iodide treatment. There is nearly as much vomiting among the cases which are cured as among those which relapse.

(4) The age of the patient has no effect upon the chance of cure by the drug. But there is evidence to show that men over forty years of age vomit less while undergoing treatment.

(5) The salol-coated pills are a distinct improvement upon the keratin-coated tabloids from a curative point of view. They also cause less vomiting and loss of weight.

In conclusion we express our hearty thanks to Temporary Honorary Captain A. C. Inman, R.A.M.C., Mr. W. O. Redman King and Mr. A. G. Thacker for making some of the examinations for us and for help in many ways.

To Lieutenant-Colonel T. H. F. Clarkson, R.A.M.C., Officer Commanding, Mont Dore Military Hospital, Bournemouth, we are indebted for permission to publish this report.

DETECTION AND TREATMENT WITH EMETINE BISMUTH IODIDE OF AMŒBIC DYSENTERY CARRIERS AMONG CASES OF IRRITABLE HEART.[1]

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(*Report to the Medical Research Committee.*)

AMŒBIC dysentery as a direct or aggravating cause of irritable heart was found amongst soldiers returned from the Mediterranean Force [1]. It was therefore considered of importance in dealing with this condition to determine the number of cases who were carriers, and to attempt to cure them. From October, 1916, to February, 1917, we examined the stools of all cases from the Mediterranean Force who were admitted to the Hampstead Military Hospital suffering from irritable heart. No selection of the men was made in so far as the presence or absence of a history of dysentery was concerned. In all sixty-five cases have been examined, of which twenty-five had a definite history of dysentery.

INFECTIONS.

The microscopic examinations of the stools were made in the usual way, and we aimed at giving each man at least six careful examinations[2] before discharging him as uninfected. How far we were able to carry this out the following figures will show:—

Number of cases who had 6 or more examinations	51
,, ,, ,, 5 ,, ,, ...	1
,, ,, ,, 4 ,, ,, ...	8
,, ,, ,, 3 ,, ,, ...	3
,, ,, ,, 2 ,, ,, ...	1
,, ,, ,, 1 ,, ,, ...	1
	65

[1] This work was done at the Hampstead Military Hospital. The treatments were carried out by one of us (J.C.M.) and the examinations made by the other (M.W.J.).

[2] This was done at the suggestion of Mr. Clifford Dobell.

The following infections were detected:—

Entamœba histolytica ..	in 24 cases	..	i.e., 36·9 per cent total cases.	
E. coli	,, 32 ,,	..	,, 49·2 ,,	,,
Lamblia intestinalis ..	,, 20 ,,	..	,, 30·8 ,,	,,
Chilomastix mesnili ..	,, 3 ,,	..	,, 4·6 ,,	,,
Trichomonas hominis ..	,, 1 case	..		—

Entamœba nana (Wenyon and O'Connor) was found as the active free amœba in one case; and its cysts were found in others. Their occurrence was not always recorded, however, so that no indication of the frequency of this infection can be given. The so-called "iodine-cysts" of Wenyon were found in six cases [3], and the eggs of *Trichuris trichiura* (= *Trichocephalus dispar*) in two.

The percentages are, of course, of little absolute significance in so small a number of cases. It was to be expected that they would be higher than some of the corresponding figures obtained elsewhere by a smaller number of examinations per case [2]. That the larger number of examinations accounts in part at least for the exceptionally high proportion of infected cases may be seen in the following tables, where the examinations are shown at which infections of *E. histolytica*, *E. coli*, and *Lamblia* were detected.

TABLE I.

Examination at which detected	*E. histolytica*		*E. coli*		*Lamblia*	
	Number of cases	Percentage of cases	Number of cases	Percentage of cases	Number of cases	Percentage of cases
1st	11	16·9	14	21·5	9	13·8
2nd	3	4·5	5	7·8	1	1·6
3rd	4	6·3	5	7·8	3	4·7
4th	1	1·7	1	1·7	1	1·7
5th	2	3·8	2	3·8	1	1·9
6th	2	3·9	1	2·0	2	3·9
Totals	23	—	28	—	17	—
8th	—	—	1	—	—	—
9th	—	—	1	—	—	—
10th	1	—	—	—	—	—
14th	—	—	1	—	1	—
28th	—	—	1	—	—	—
32nd	—	—	—	—	1	—
47th	—	—	—	—	1	—
Totals	24	—	32	—	20	—

The percentages for each examination are worked out on the number of cases who had at least that number of examinations. Table II shows the total number of infections found after each of the first six examinations among the fifty-one cases who had at least six examinations each.

TABLE II.

Number of examinations	*E. histolytica*		*E. coli*		*Lamblia*	
	Number of cases	Percentage total cases	Number of cases	Percentage total cases	Number of cases	Percentage total cases
1	8	15·7	12	23·5	8	15·7
2	10	19·6	14	27·4	8	15·7
3	14	27·4	18	35·3	10	19·6
4	15	29·4	19	37·3	11	21·6
5	17	33·3	21	41·2	12	23·5
6	19	37·3	22	43·1	14	27·4

It is clear that infections were detected on every examination, including the sixth and last. That even this does not represent the actual total number of infections is demonstrated by the few figures given for still later examinations in the lower half of Table I, which gives the results of twenty-three extra examinations made on twelve negative cases, and of the examinations made during and after treatment on some of the positive cases. These are given merely as further examples of infections not detected in a small number of examinations.

The E. histolytica Carriers.

It is of interest to note that among this series of twenty-four carriers in no less than twelve cases no *E. histolytica* cysts measuring over ten microns in diameter were ever observed. These small cysts measuring six to ten microns in diameter have been described by several authors (see [4]), but rather as an abnormal form of rare occurrence. Such infections may be exceedingly difficult to detect even when specially looked for, and it has often been necessary to fix and stain films before a certain diagnosis could be made. The cysts are very easily overlooked when present in the stool in small numbers, particularly if many other small bodies such as *Chilomastix* cysts, some of the yeasts, pus cells, etc., be present at the same time. For example, case No. 13 was not found positive until the tenth examination (Table I), although very careful search was made for *E. histolytica*, as large quantities of pus with blood and mucus were usually present in the stool, and the bacteriological report was negative. The cysts were extremely rare, and measured about seven microns in diameter. They disappeared after treatment (*v. infra*), and the clinical condition of the patient improved. The twelve infections in which only small cysts were detected were as under:—

Examinations		Number of cases detected
1st :	Nos. 23, 24	2
2nd :	Nos. 9, 20, 22	3
3rd :	No. 10	1
4th :	No. 7	*1
5th :	Nos. 8, 19	2
6th :	Nos. 18, 21	2
10th :	No. 13	1
		12

These figures on comparison with Table I show that in this series it happened that no infection of *E. histolytica*, where typical large cysts were found, was detected after the third examination. This is probably due to chance, and not to the fact that all such infections can be detected in three examinations only. There is naturally a decrease in the number of infections detected at each succeeding examination, and little evidence, if any, that *E. histolytica* differs in this respect from *E. coli* and *Lamblia*, both of which were sometimes discovered at the sixth and later examinations [2].

In one other case (No. 11) the diameter of the *E. histolytica* cysts varied from seven to fifteen microns, all intermediate sizes being observed (cf. [4]).

TREATMENT.

Emetine bismuth iodide when given in a powder generally causes nausea and vomiting. In order to overcome these conditions three preparations of the drug were tried. These were experimental preparations, prepared by three different firms, and were submitted to us for trial. They were all in tablet or pill form, and were either mixed or coated with some material supposedly insoluble in the stomach. In all, twenty-three courses of treatment were given with these preparations. In no case was nausea or vomiting produced; but in eight cases (thirty-five per cent) severe diarrhœa and abdominal cramps occurred. Some looseness of the bowels was observed in all cases where the drug appeared to have any action. The results obtained with these preparations are shown below. In these tables "relapsed" signifies that *E. histolytica* was again detected in the stools, and "unaffected" that no negative period was observed during or after treatment.

*Case No. 12 was often negative for a few days while untreated. Thus different measures of success were obtained with these different preparations. With the first preparation there were eight cures out of twelve cases treated, or 66 per cent. With the second there were no cures, while with the third there was only one cured out of four cases treated, or 25 per cent. Of the three preparations, the first was the only one which gave sufficiently good results to justify its use in preference

to the drug given in a powder (see below). But even the proportion of cures with this preparation is not sufficiently high to warrant its general use.

TABLE III.—TREATMENT WITH STEARIN-COATED TABLETS (A.).

Case No.	Treatment Began	Treatment Ended	Dose	Consecutive negative examinations after treatment	Result
				No. Days	
2	27.10.16	8.11.16	36 gr.	24 in 34	Discharged as cured.
1	25.10.16	6.11.16	36 ,,	26 ,, 35	,, ,, ,,
3	26.10.16	7.11.16	36 ,,	34 ,, 40	,, ,, ,,
7	6.11.16	17.11.16	36 ,,	31 ,, 46	,, ,, ,,
6	6.11.16	17.11.16	36 ,,	23 ,, 46	,, ,, ,,
4	3.11.16	15.11.16	36 ,,	4 ,, 5	Relapsed 22.11.16
5	7.11.16	18.11.16	36 ,,	12 ,, 22	,, 16.12.16
17	31.10.16	12.11.16	36 ,,	..	Unaffected.
	24.11.16	8.12.16	36 ,,	..	,,
	19.12.16	20.12.16	36 ,,	..	,,
8	18.11.16	29.11.16	36 ,,	25 in 33	Discharged as cured.
10	2.12.16	15.12.16	39 ,,	22 ,, 26	,, ,, ,,
9	24.11.16	5.12.16	36 ,,	12 ,, 2	Relapsed 8.12.16
13	29.12.16	9.1.16	36 ,,	17 ,, 21	Discharged as cured.

TABLE IV.—TREATMENT WITH STEARIN-COATED PILLS WITH RESIN OINTMENT BASIS.

Case No.	Treatment Began	Treatment Ended	Dose	Consecutive negative examination after treatment	Result
				No.	
12	11.12.16	22.12.16	36 gr.	0	Unaffected.
14	18.12.16	29.12.16	36 ,,	0	,,
15	18.12.16	29.12.16	36 ,,	0	,,
11	11.12.16	22.12.16	36 ,,	0	,,
13	13.12.16	24.12.16	36 ,,	0	,,

TABLE V.—TREATMENT WITH STEARIN-COATED TABLETS (B.).

Case No.	Treatment Began	Treatment Ended	Dose	Consecutive negative examition after treatment	Result
				No. Days	
*12	29.12.16	6.1.17	27 gr.	2 in 5	Relapsed 11.1.17
14	30.12.16	6.1.17	24 ,,	18 ,, 23	Discharged as cured.
	11.1.17	22.1.17	36 ,,		
15	30.12.16	6.1.17	24 ,,	0	Unaffected.
	11.1.17	22.1.17	36 ,,		
11	29.12.16	6.1.17	24 ,,	0	,,
	11.1.17	22.1.17	36 ,,		

The objection to the use of emetine bismuth iodide in the form of a powder, given in a cachet or capsule, has been the occurrence of nausea and vomiting. We have treated eleven cases with cachets, and these

symptoms occurred in all of them. The drug was given with a hot drink at 9 p.m. after the patient was in bed. The time of the vomiting after the drug was taken varied in different individuals as is shown in Table VI.

TABLE VI.

Number of cases	Nausea and vomiting occurred during the—			
	1st hour	2nd hour	3rd hour	4th hour
11	0	3	6	2

It is evident from this table that the nausea and vomiting occurs most frequently after the stomach is presumably empty. These symptoms fortunately did not persist during the whole course of treatment. The toxic symptoms disappeared after a time as if a tolerance had developed (cf. [5 and 6]). The duration of these symptoms is tabulated in Table VII.

TABLE VII.

Number of cases	Nausea and vomiting disappeared after—											
	1st day	2nd day	3rd day	4th day	5th day	6th day	7th day	8th day	9th day	10th day	11th day	12th day
11	0	0	1	2	3	4	0	0	1	0	0	0

Eleven cases were treated with emetine bismuth iodide in cachets of three grains each. Ten cases (ninety-one per cent) were cured after twelve daily doses (Table VIII).

TABLE VIII.

Case No.	Treatment		Dose	Consecutive negative examination after treatment	Result
	Began	Ended		No. Days	
9	12.12.16	23.12.16	36 gr.	23 in 28	Discharged as cured.
4	29.12.16	9.1.17	36 ,,	18 ,, 24	,, ,, ,,
5	18.12.16	29.12.16	36 ,,	10 ,, 24	,, ,, ,,
17	13.1.17	24.1.17	36 ,,	2 ,, 4	Relapsed 28.1.17
12	26.1.17	7.2.17	36 ,,	7 ,, 24	Discharged as cured.
15	26.1.17	6.2.17	36 ,,	9 ,, 23	,, ,, ,,
11	26.1.17	6.2.17	36 ,,	10 ,, 23	,, ,, ,,
16	3.2.17	14.2.17	36 ,,	9 ,, 24	,, ,, ,,
18	19.2.17	1.3.17	36 ,,	10 ,, 96*	,, ,, ,,
19	9.3.17	22.3.17	36 ,,	5 ,, 29	,, ,, ,,
20	9.3.17	21.3.17	36 ,,	5 ,, 30	,, ,, ,,

* We are indebted to Dr. G. C. Low for facilities for making the last four examinations of this case, after he had been transferred to another hospital.

The one case which was not cured had previously resisted three courses with the first preparation described above. The results obtained with the drug administered by this method are much more encouraging than those obtained with any of the other preparations.

In Table IX the results obtained with the various preparations are compared.

TABLE IX.

Case No.	1st Preparation (Table III)		2nd Preparation (Table IV)		3rd Preparation (Table V)		Cachets (Table VIII)	
	Cures	Failures	Cures	Failures	Cures	Failures	Cures	Failures
1	1	0	..	..	..	..	..	..
2	1	0	..	..	..	..	..	..
3	1	0	..	..	..	..	..	..
4	0	1	..	..	..	..	1	0
5	0	1	..	..	..	..	1	0
6	1	0	..	..	..	..	..	..
7	1	0	..	..	..	..	..	..
8	1	0	..	..	..	..	..	..
9	0	1	..	..	..	..	1	0
10	1	0	..	..	..	..	..	..
11	..	..	0	1	0	1	1	0
12	..	..	0	1	0	1	1	0
13	1	0	0	1	..	..	..	..
14	..	..	0	1	1	0	..	..
15	..	..	0	1	0	1	1	0
16	..	..	..	..	..	..	1	0
17	0	1*	..	..	..	..	0	1
18	..	..	..	..	..	..	1	0
19	..	..	..	..	..	..	1	0
20	..	..	..	..	..	..	1	0
—	8	4	0	5	1	3†	10	1

* Three separate courses. † See Table V.

All the patients treated were suffering from symptoms of irritable heart. Any possible effects of the removal of the *E. histolytica* infection on the symptoms of this condition were carefully looked for. Of the twenty cases which were cured, eleven (fifty-five per cent) showed a conspicuous improvement, while nine (forty-five per cent) showed little or none. The degree of improvement was determined by their increased ability to perform graduated exercises without untoward symptoms [1]. Cases which, before treatment, showed severe symptoms after performing mild exercises could afterwards accomplish the more advanced exercises with comparative ease. This confirms the previous conclusion that the removal of a co-existing infection may lead to the alleviation of symptoms of irritable heart [1].

Treatment with Methyl-Psychotrine.

In addition to these treatments with emetine bismuth iodide we tested a new alkaloid, methyl psychotrine, prepared from ipecacuanha

by Dr. F. L. Pyman, and sent to us for trial by Dr. H. H. Dale, F.R.S. Two cases were treated with this drug, the results being shown in the following table:—

TABLE X.—TREATMENT WITH METHYL-PSYCHOTRINE.

Case No.	Treatment		Total amount given	Result
	Began	Ended		
11	13.11.16	—	108 gr.	Unaffected.
12	26.11.16	—	54 ,,	,,

As will be seen from the table the drug appears to have had no effect whatever upon the *E. histolytica* infections in spite of the large amounts administered. Case No. 11 had daily doses of the drug increasing up to a total of 108 grains. Case No. 12 daily increasing doses to a total of 54 grains. In both cases the drug appeared to be quite non-toxic to the patients. Both were subsequently treated with emetine bismuth iodide, and apparently cured of their infections as shown in Table VIII. Case No. 11 also had a heavy infection of *Lamblia*, which was not affected by the methyl psychotrine.

TABLE XI.

Case No.	Date of count	Infections in addition to *E. histolytica*	Differential count* (percentage of 400 cells counted)					
			Poly-nuclears	Small lympho-cytes	Large lympho-cytes	Eosino-phils	Large mono-nuclears	Baso-phils
4	3.11.16	Lamblia ..	54	12·75	27·5	3·75	1·5	0·5
5	3.11.16	—	51·25	21·75	23·75	2·75	0·25	0·25
	17.1.17		48	8·5	38·75	1·25	3·25	0·25
8	18.11.16	*E. coli*	55	26·5	14	2·25	1·75	0·5
	20.12.16		60	18·75	18·75	1	1	0·5
9	4.12.16	*E. coli*, Lamblia	43·75	22	30·75	0·75	2·75	—
11	17.11.16	Lamblia ..	48	26·25	17·75	4	3	1·5
10	28.11.16	*E. coli*, Lamblia	55·75	24	16·75	2	1·25	0·25
12	24.11.16	*E. nana* ..	55	10·5	26·75	5	1·5	1·25
13	13.12.16	*E. coli*	53	17·5	25·75	2·25	0·75	0·75
14	16.12.16	Lamblia ..	52·25	14	30·25	1·75	1·5	0·25
15	16.12.16	*E. coli*, Chilo-mastix	53·25	8·5	33·5	1·5	2·25	1
17	3.11.16	(?) *E. coli* ..	52·75	20·25	23·75	2·25	0·75	0·25

* The classification used was that given by Cabot in Osler and McCrae's "System of Medicine," 1915 (see *Lancet*, June 2, 1917).

DIFFERENTIAL BLOOD COUNTS.

Mrs. Briscoe, M.B., B.S.Lond., has very kindly given us the result of some differential leucocyte counts which she made on some of our carriers. These are shown in Table XI. Mrs. Briscoe says: "They all show the high lymphocyte counts relative and absolute so frequently found in cases

of "irritable heart," and they do not show any marked increase either in the eosinophils or large mononuclears. In fact, there is nothing in these counts to distinguish these men from other men suffering from "irritable heart." This is in agreement with Dr. G. C. Low's findings in cases infected with intestinal protozoa (7 and 8).

ACKNOWLEDGMENTS.

We take this opportunity of recording our indebtedness to Dr. H. H. Dale, of the biochemical department of the Medical Research Committee, and to Mr. Clifford Dobell, for very many helpful suggestions, and for the practical interest which they have always taken in our work. Dr. Dale arranged for the supply to us of the various forms of emetine bismuth iodide; the methyl psychotrine used in the treatments here described was kindly furnished, through Dr. Dale, by Dr. F. L. Pyman, Director of the Wellcome Chemical Research Laboratories; while Mr. Dobell has given invaluable assistance with the protozoological examinations, especially by his confirmation of the occurrence of small cysts of *E. histolytica* in the large proportion of carriers mentioned above. The opportunity is very gladly taken of expressing our sincere gratitude to him for his extremely kind and constant interest.

We are indebted to Lieutenant-Colonel J. More-Reid, R.A.M.C., Officer Commanding Hampstead Military (Mount Vernon) Hospital, for permission to publish this account of cases in his hospital.

CONCLUSIONS.

(1) Additional infections with intestinal protozoa may be detected at the sixth and later examination.

(2) Infections of *E. histolytica* in which no cysts measuring over ten microns in diameter are found in the stools are far from uncommon.

(3) The use of emetine bismuth iodide has cured a large proportion (ninety-five per cent) of our amœbic dysentery carriers.

(4) The best method of administration of this drug is in the form of the loose powder in cachets, in daily doses of three grains. At least thirty-six grains should be given in all.

(5) Symptoms of irritable heart are reduced in a large number of those patients who have been cured of the amœbic infection.

(6) Infection with intestinal protozoa has no marked effect on the differential leucocyte count.

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[2] Special Report Series No. 4, of the Medical Research Committee, "Amœbic Dysentery," etc. (Dobell) 1917, p. 51.
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[6] LOW and DOBELL. *Lancet*, August 19, 1916.
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A NOTE ON A SIMPLE METHOD OF REPAIRING DEFECTS OF THE SCALP.

By Colonel CUTHBERT WALLACE, C.M.G.

Consulting Surgeon, Expeditionary Force.

It is now recognized that it is beneficial in many cases of gunshot wound of the cranium to cover up the exposed brain tissue. When there is a loss of scalp and the loss accentuated by the excision of the wound, it is not always possible to bring the edges together. Lateral

Fig. 1.

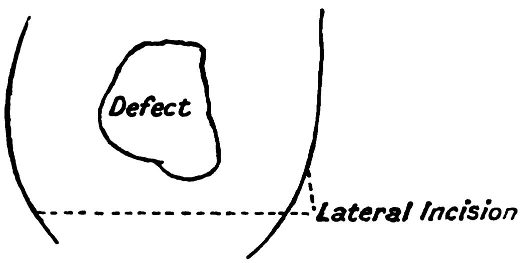


Fig. 2.

Fig. 3.

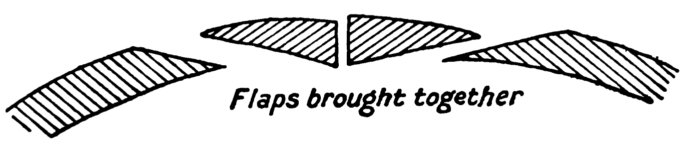
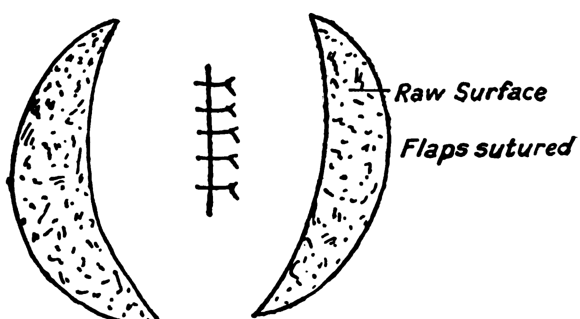


Fig. 4.



tension-relieving incisions have the disadvantage of leaving the bone bare. If, however, the knife in making the lateral cuts is introduced at an angle to the surface, the scalp is cut on the bevel and the tension is relieved without exposing the bone.

The diagrams explain the method which is applicable, whether a large exploratory flap has been used or not.

A CASE OF ACUTE TORSION OF THE WHOLE MESENTERY OF THE SMALL INTESTINE.

By Captain R. P. GARROW.
Royal Army Medical Corps.

Acute torsion of the whole mesentery of the small intestine is an abdominal catastrophe which appears to be so rare as to warrant the publication of one case.

Case.—Pte. T. S., aged 20, while in the trenches was seized at 8 a.m., on April 30, 1917, with pain in the abdomen, vomiting and diarrhœa. He passed five stools on April 30, 1917 which, he said, were loose and black. He was admitted as a case of diarrhœa or dysentery to the casualty clearing station at noon on May 1, 1917. One-quarter of a grain of morphia had been given by the mouth two hours before admission. On admission, he complained of very severe pain in the abdomen, with cramps in the thighs. Pulse 140, small and flabby; respirations hurried; skin cold; facies pale and distressed; perspiring profusely; heart and lungs normal. Abdomen soft and easily palpated; no distension. The patient was obviously extremely ill, and the diagnosis suggested by those who saw him were: Dysentery, cholera, ptomaine poisoning, abdominal malaria, "acute abdomen." The last-mentioned diagnosis was withdrawn in favour of dysentery, and he was treated, without benefit, as a case of acute bacillary dysentery. No cholera-like vibrios were found on direct microscopic examination of the stools. The patient's general condition became worse, he vomited watery mucus and bile, and passed a small watery and mucous, colourless motion. At 4 p.m., the abdomen was distended and somewhat resistant, though not hard. Temperature at 4 p.m. was 101° F. The abdominal distension increased rapidly and the general condition became graver till death supervened at 7.30 p.m., that is, about thirty-six hours from the onset of symptoms.

Post-mortem.—When the abdomen was opened an hour after death the condition found was acute torsion of the whole mesentery of the small intestine. The small intestine itself presented a very remarkable appearance. With the exception of the duodenum, together with nine inches at the upper end of the jejunum, and three inches at the lower end of the ileum, the entire length of the small intestine was of a deep plum colour, and was greatly dilated so as to fill the distended abdomen. The lumen was filled with ordinary intestinal contents, plus much blood and gas. The surface was smooth and glistening throughout. There was no peritonitis. Behind this mass of dilated and blood-engorged intestine could be felt a hard, rope-like structure about the thickness of the finger, stretched tightly over the bodies of the lumbar vertebræ in a direction from above downwards and to the right. This was found to be the mesentery of the small intestine twisted on itself from left to right, that

is, in the direction of the hands of the clock. By seizing the whole mass of intestine between the outstretched fingers of both hands and turning it from right to left for three and a half turns, that is, about 1,260°, the torsion of the mesentery was undone, and the parts occupied their normal positions. The mesenteric glands were normal on inspection *in situ.*

No apparent cause could be found for the condition discovered at the autopsy. The small intestine was not in a state of gangrene, but of intense engorgement with blood, which was due to mechanical interference with the mesenteric circulation; first, the arrest of the venous return from the gut, and, later, as torsion became more marked, and compression greater complete arrest of the flow in both veins and arteries.

Weible,[1] who describes a case which he operated on successfully, was able to obtain from the literature particulars of sixty-six cases of which twenty-three recovered after operation. His communication contains an excellent *résumé* of these cases. An interesting fact is that the usual amount of torsion was about 180° only, in two of the cases it was as much as 720° (two complete turns). Our case, which showed three complete turns and a half (about 1,260°), would, therefore, appear to be unique so far as the extent of the torsion is concerned.

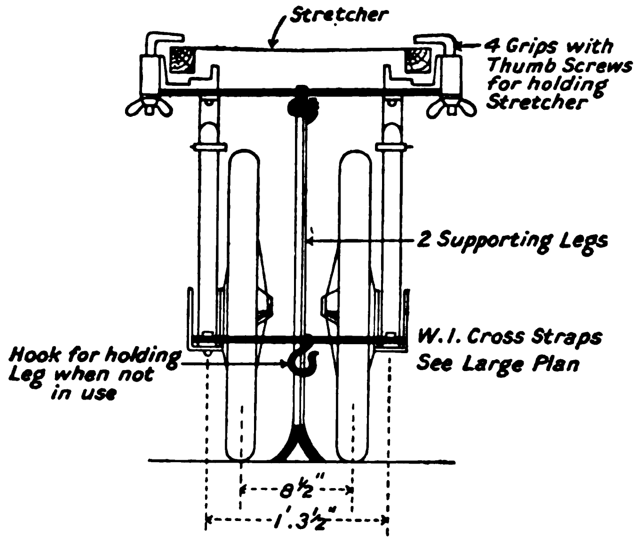
ADAPTATION OF THE MILLER-JAMES STRETCHER CARRIER FOR TRENCH WORK.

By Lieutenant-Colonel O. W. A. ELSNER.
Royal Army Medical Corps.

The following is a description of an adaptation of the Miller-James wheeled stretcher carrier for use in the trenches. The necessity of some such device occurred to me when working a part of the line involving a twenty-five minutes walk along the communication trench which took fully one and a half hours to accomplish by four bearers with a loaded stretcher.

The Miller-James carrier is a collapsible one with pneumatic tyres. When the wheels are approximated you have a capital twin-wheeled support for a stretcher. I therefore had two cross pieces made the width of the open stretcher, and removing the grips, which hold the stretcher, from the springs, fixed them to either end of the cross pieces. The springs were then fixed to the cross pieces by bolts and nuts (using the same holes). This completed the job. We used this carrier all the time

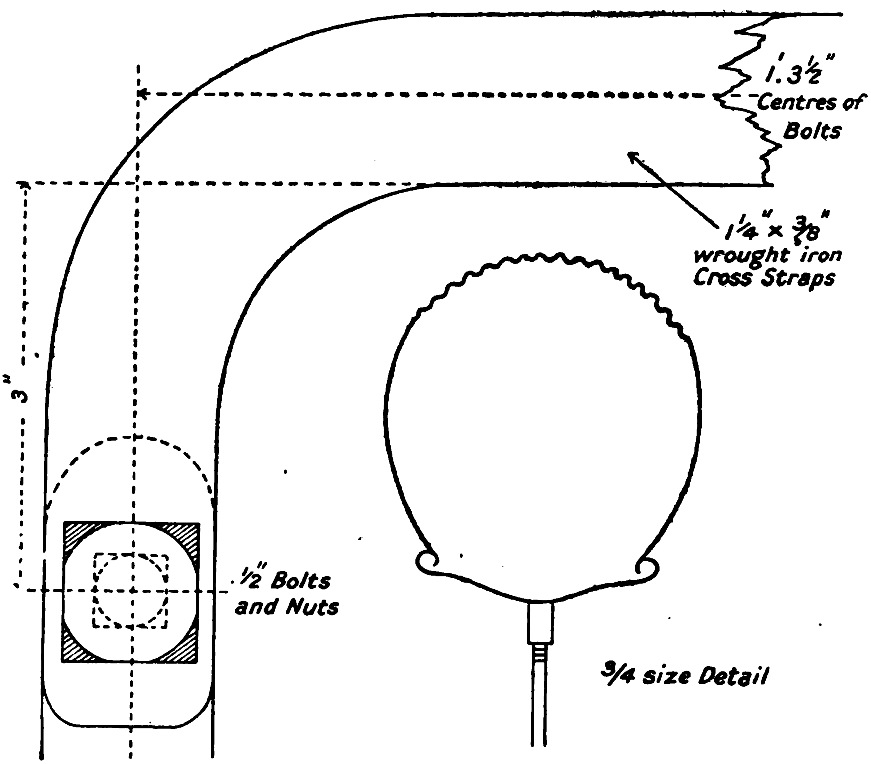
[1] "Volvulus: Torsion of the whole Mesentery. (Report of a case with Résumé of Literature.") By Ralph E. Weible, M.D., Fargo, North Dakota. Surgery, Gynecology and Obstetrics, vol. xix. July to December, 1914, p. 644.



Thick black lines indicate new parts.

END ELEVATION

Scale ¾ of an inch = 1 foot.



¾ size Detail

we were in this district and the bearers found it a great boon and as the trench was duck-boarded all the way two bearers could bring a stretcher case down in three-quarters of an hour. Also the whole apparatus and patient could be lifted round awkward corners. The objection was that the apparatus was unsteady, badly balanced. It then occurred to me to turn the wheels round by unscrewing the nuts in front and behind the extension straps, thereby placing the springs outside and the wheels inside (as in the plan) the two being held in position by two W.I. cross straps fixed by bolts and nuts.

The wheels are thus 9½ inches apart (which will take any duck-board) and the whole carrier and stretcher being so well-balanced that one man conld manipulate it alone, which, of course, is not necessary.

The carrier can be reconverted to its original form by simply unscrewing the various bolts, turning the wheels round again and rebolting. A return to the old pattern, however, is not necessary, as the carrier is just as handy on the open road in this form.

COMPLETE FRACTURE OF THE UPPER JAW.

By Lieutenant HERBERT J. FOOKS.
Royal Army Medical Corps.

A rather unusual case came into my hands which I think may interest members of the medical and dental professions.

It was a case of a complete fracture of the whole upper jaw, and was the result of an accident to an officer attached to the Royal Flying Corps, when alighting. His goggles shifted over his eyes and in trying to adjust them certain things happened, which he cannot recollect and he nose-dived to earth. After the accident he was found with the engine of the aeroplane lying across his legs, quite conscious, but had received a hard blow in the face, which evidently caused the fracture. When seen on admission to hospital, it was found that the whole of the upper jaw dropped nearly half an inch when the patient opened his mouth, going back easily into place on closure.

An X-ray photograph gave little help in diagnosis, but it was clear on examination that the lower part of the anterior border of the vomer was badly broken and splintered, and the rest of the bone was separate from the superior maxilla.

In my opinion the fracture extended on both sides from the nasal cavity just below the nasal processes diagonally across to under surface of malar process and ending above the tuberosity.

The anterior nasal spine was also splintered, and in the soft tissues below there was a cut which extended into the mouth to the sulcus above the four upper incisor teeth.

Of course the face was very badly bruised and swollen, and there was

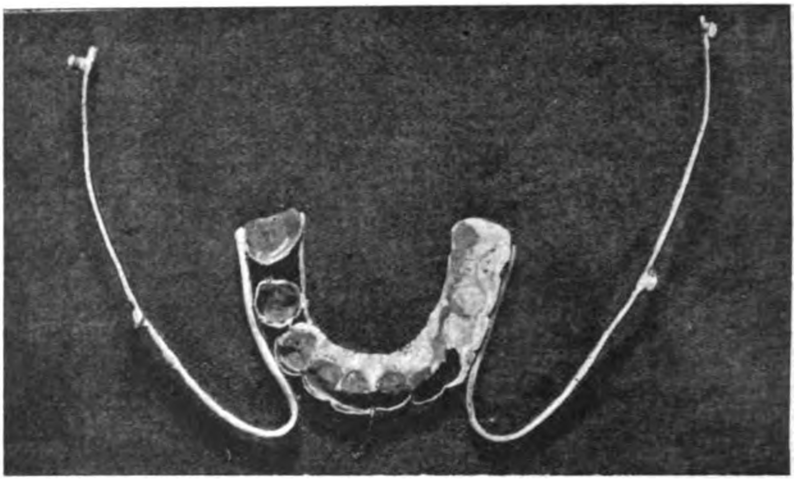


Fig. 1.

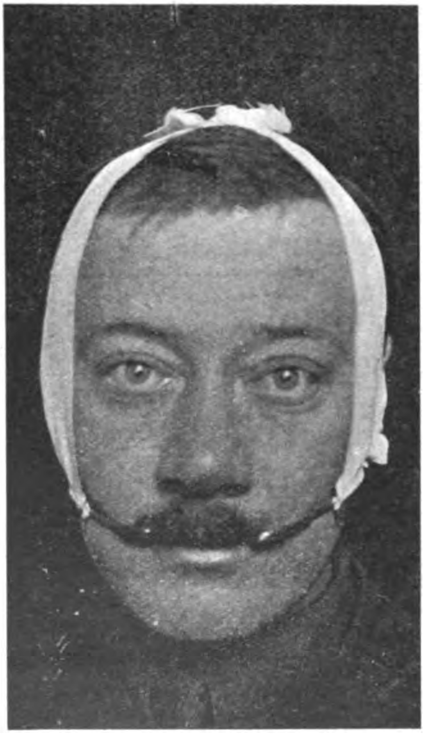


Fig. 2.

Fig. 3.

also a fair amount of hæmorrhage from the nose and mouth. A strange feature was, that the nasal bones were not fractured, neither was the mandible damaged at all. The immediate treatment was naturally to render the mouth aseptic by means of a mouth wash of H_2O_2 ten volumes (one dessert spoonful to half tumbler of water), this being used frequently, also a nasal douche (sod. chlor., sod. bicarb. and sod. bibor). to keep the lacerated parts as healthy as possible. Thin pieces of cork were also placed between molars of upper and lower jaws and a four-tail bandage applied to prevent any movement.

At the end of ten days, impressions were taken of upper and lower jaws, and a splint of Victoria metal made to cap all the upper teeth. To this was soldered two long lengths of Ash's Victoria metal oval shaped wire of the thickest gauge made, from last standing molar on either side to each canine. These wires were turned outwards to pass between the lips and then backwards, outside the cheeks, and cut off on a level with posterior margin of ascending ramus of the mandible (fig. 1). Two two-inch bandages about one yard in length were sewn to outside lengths of wire on either side, one behind the other. The splint was applied two days after the impressions were taken and tied in position over the top and back part of the head. The posterior bandage on either side being carried up at right angles to splint, and tied firmly enough to prevent any movement up or down, and the anterior bandages carried back over the ears and tied firmly in the occipital region to prevent any forward movement (figs. 2 and 3).

The bite was adjusted in this case very easily, and kept in the proper position by the bandage attached to splint. The original four-tailed bandage was discarded, the lower jaw being left free, and the patient was able to get up, go outside, and make the best of life under the circumstances. Every morning he paid a visit to the Dental Surgery for the purpose of having his mouth well syringed out with strong H_2O_2 solution, and also to have the bandages tightened when necessary.

He was kept under observation for a period of eleven weeks, and then sent off on sick leave for fourteen days. At the end of that time he returned for inspection. The splint was then discarded, and he was sent away for another fourteen days sick leave. On the completion of this he reported to me, and from his conversation I gathered that his diet consisted of ordinary food which he masticated without the slighest trouble or discomfort. On looking at the bite, I found perfect articulation with lower teeth.

During the time he was in hospital his diet was entirely of milk, milk puddings, custards, soup, etc., but during the first fortnight of his sick leave he ate fish, chicken, minced meat, and other boiled food.

X-rays were taken on three occasions, and the last one after ten weeks showed density in the region of the vomer pointing to formation of bone.

The patient, being anxious to return to duty, carried out my instructions to the letter, and this was of great assistance to me.

I extend gratitude to Captain W. E. Jones, R.A.M.C., to whom I referred at different times for his assistance and advice.

The splint was made at the Army Dental Worshop, Military Hospital, Tidworth, under my supervision, by Corporal W. Welsh, R.A.M.C.

A NOTE ON THE MANAGEMENT AND IMPORTANCE OF CHRONIC OTITIS MEDIA.

By Lieutenant-Colonel J. W. BARRETT, C.M.G., M.D., M.S., F.R.C.S.Eng.

A note appears in the November number of the Journal of the Royal Army Medical Corps, from the pen of Major James Kerr Love. The title of the note is "Hearing in the Army," and the note raises a number of problems to which I desire to make very brief reference.

Those experienced in the matter will entirely agree with the statements made by him that:—

(1) Most of the cases of deafness amongst those invalided home are due to middle ear suppuration; and (2) that middle ear suppuration has in most cases existed before the War began—indeed for years before the enlistment of the soldier.

The question, however, immediately arises, is it necessary to invalid a soldier because he has a suppurating ear? Statistics, I understand, cannot be published during the continuance of the War, but those who are thoughtful may well ask what would be the practical effect of agreement with such a policy? The facts are that the majority of cases of suppurating ear possess good or fair hearing; of the minority, a number can be much improved by treatment, and the residuum of cases, in which the hearing is greatly deficient, or the discharge unmanageable, is comparatively small in number. The great majority of these cases have existed for considerable periods of time and have not been subjected to regular treatment. When placed under regular supervision and treatment, by the purification method they do very well. The treatment can be applied without much difficulty at the front, subsequent to preliminary treatment at the base.

Furthermore, is it not obvious that this is a national war, and is being waged by a national army, and that as these men, in civil life, are able to earn a living in some capacity, so when the nation has turned its attention to military matters there must be some occupation in which even those with defective hearing, can find opportunity for useful service? Is it not the case that the problem usually faced in recruiting has now

been completely altered? An army of limited size can be, and should be, composed of picked men with as few defects as possible, but the existence of the same standard in a national war may make a serious difference to the number of men available.

So far as the test of hearing is applied on admission with the object of eliciting remediable defects, there can be no criticism, but I should be sorry to depend on the answers to test questions for a determination of the acuity of hearing of all recruits. Nothing in my judgment is so difficult as the determination of the amount of hearing possessed by anyone who is unwilling to hear, and candidates who may desire to evade service would be very difficult to deal with by the estimation of their capacity to hear whispering at specific distances. It is true that this criticism will not apply to the great majority of candidates, but amongst the minority the person who will offer the most difficulty is he who possesses some aural disease and tries to make the most of it. For this type of candidate there is no more suitable method of testing than the use of the tuning-fork with the various devices well known to aurists.

Nothing has been more striking in my experience of suppuration of the middle ear than the infrequency of general septicæmia. Ears wholly neglected by men for many years rarely land their possessor in serious trouble. Whether their comparative immunity is due to the free exit of discharge, to the developing of antibodies, or to the creation of an anatomical bar to infection, it is difficult to state, but of the fact there is no doubt whatsoever, and those who have handled considerable numbers of cases have been surprised at the relative infrequency with which the radical mastoid operation is necessitated. The purification method of treatment carried out under discipline reduces the problem to very small proportions. The experience of the War will cause many of us to modify our notions respecting the management of chronic otitis media.

LIGATION OF THE INNOMINATE ARTERY FOR TRAUMATIC ANEURISM OF THE CAROTID.

By Colonel THOMAS SINCLAIR, F.R.C.S.

Army Medical Service; Consulting Surgeon to the Fourth Army, B.E.F.

Since the successful ligation of the "innominate artery," by A. W. Smyth, of New Orleans, in 1864, this vessel has occasionally been tied, though not so frequently as to render uninteresting a description of a recent case. It may also be desirable to record it as a contribution to the statistics of military surgery in the present War.

A young officer, aged 20, was shot on August 24, 1916, in the lower part of the right anterior triangle, the bullet issuing close to the superior

angle of the scapula on the same side. He lay out for thirteen hours, during which time he bled so profusely as to saturate his tunic and necessitate dressing four times.

He was admitted to a casualty clearing station on August 25, 1916, and, though he recovered speedily from shock, he showed marked anæmia. A traumatic arterial aneurism formed in the lower part of the common carotid, which was treated expectantly for some days, but the rapid daily enlargement compelled operation on the fourteenth day. By this time the aneurism had attained the size of an orange, filling up the interval between the clavicle and the upper border of the thyroid cartilage, extending across to the line of the common carotid of the left side, and overhanging the subclavian on the right. Its approximate measurements were 4½ inches in breadth by 4 inches in height. Hoarseness developed in the later days, pointing to pressure on the recurrent laryngeal nerve. The respirations were 24; the temperature varied from 100° to 101·8° F., and the pulse from 100 to 112. Both entrance and exit wounds suppurated moderately.

Operation.—The artery was exposed by a rectangular incision in the mid-line and along the clavicle. After detachment of the sternal head and part of the clavicular head of the sterno-mastoid and partial division of the sterno-hyoid and sterno-thyroid muscles, it was found that no space was available between the clavicle and the aneurism. Therefore 1¼ inches of the inner end of this bone were resected. The apex of the lung with its uninjured pleura appeared in the dissection. The inferior thyroid veins and the larger veins were retracted without damage—in fact, no artery or vein was clipped or ligatured throughout the operation. The innominate artery was found behind the middle of the manubrium, and, in tracing it upward, it became apparent that the common carotid was so incorporated in the aneurism that the placing of a ligature upon it was impracticable, and therefore the innominate was tied with a single strand of No. 4 thirty-day catgut. The muscles were repaired with catgut sutures, and a small drain-tube left in for forty-eight hours.

The question of a distal ligature was now debated in obedience to the commonly accepted principle that the wounded artery should be doubly ligated, and the contents of the sac turned out, or the sac excised, but these measures were advisedly omitted in this instance, lest a copious bleeding from the sac in a markedly anæmic subject, or the prolonging of an already lengthy operation, should jeopardize the patient. It was felt that a distal ligature could be placed on the carotid some days later, should the progress disappoint. Fortunately, the need for this step did not arise.

The subsequent course was uneventful; no septic changes from the original bullet-track were propagated to the operation wound, and the patient was evacuated to the base on September 16, 1916.

Three months after operation (December 13, 1916), an examination of the patient showed that no cerebral deterioration had resulted; his mental

functions were normal. The vision of the right eye was perfect, though the vessels in the fundus were slightly reduced in size. There was no giddiness or disturbance of equilibration. The thrill, bruit, and pulsation could not be detected, and the aneurismal swelling had entirely disappeared. A degree of muscular atrophy and absence of the end of the clavicle rendered this examination more easy and convincing. Radial and ulnar pulses had not returned at the wrist; the circulation and sensation in the hand were good, but some feebleness with stiffening at the fingers remained, due, probably, to the prolonged disuse of the extremity rather than to tropho-neurotic changes. No doubt, massage and exercises will remedy this temporary disablement. A satisfactory pseudo-arthrosis had formed with the first costal cartilage, and active shoulder and elbow movements were good.

The chief anxieties, apart from the immediate risks at the time of the operation, are secondary hæmorrhage, septic complications in the neck and chest, embolism, and cerebral softening from ischæmia. Disastrous cerebral changes, which may begin in forty-eight hours or be delayed for a fortnight or longer, are more likely to arise in patients over 40 with arterio-sclerosis; but acute anæmia from recent hæmorrhage may render even young persons liable. Detachment of emboli may, of course, occur under any condition or at any age, but in the case here recorded the acceptance of some extra risk in this respect, by omitting a distal ligature of the carotid, which shuts off useful refluent circulation through subclavian branches, was considered justifiable, in the expectation that the cerebral ischæmia might be rendered less profound and sudden in a very anæmic subject,

Surgeon-General Sir George H. Makins, in his admirable paper on "Vascular Lesions in War," lays it down that, "In certain conditions a proximal ligature at the seat of election suffices to cure a false aneurism, but the method is uncertain, and should not be adopted in any situation where the sac and the opening in the vessel can be dealt with locally." In a later paragraph, dealing with "Carotid Aneurisms" in particular, he says: "Still, I think the more extensive operations must be used with judgment, since they are obviously more risky procedures if a large sac is present."

It is noteworthy that cerebral complications are more frequent after ligation of the common carotid than after ligation of the innominate artery. Deibet estimates their incidence at one-fifth, and Jordan at one-fourth, under modern surgical technique. Burns, of Memphis, in 1908, in a record of 51 innominate cases, with 11 recoveries, speaks of 6 dying from shock, 6 from cerebral complications, and the balance from septic wound infections and secondary hæmorrhage.

Various methods of exposing the innominate artery have been devised: Trephining the manubrium; vertical splitting of the manubrium; clipping away the upper margin of the manubrium, with resection

of one or both sterno-clavicular joints—even the first costal cartilage has been resected; temporary displacement of the clavicle; resection of the sternal end of the clavicle. The last-mentioned plan was adopted, and gave ample access. It was deemed better than temporary displacement of the bone, which, by its dangerous traction on the aneurism, and the subsequent difficulty of retaining it on replacement in its old socket, did not commend itself in this instance.

Major Gask, Captain Chubb, and Captain Manford kindly assisted at the operation, and took charge of the case after it; and the later treatment in London was carefully supervised by Mr. Laming Evans.

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C.N. = Clinical and other Notes.
C.L. = Current Literature.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

JULY, 1917.

EXTRACTS FROM THE "LONDON GAZETTE."

India Office,
June 12, 1917.

The following appointments have been made in India :—

ARMY HEADQUARTERS STAFF.
General Staff Branch.
Medical Branch.

To be Temporary Directors, Medical Services in India :—
Surg.-Gen. J. G. MacNeece, C.B., Army Medical Service, dated July 8, 1915.
Surg.-Gen. T. J. O'Donnell, C.B., D.S.O., Army Medical Service. dated July 13, 1916.

PERSONAL STAFF OF H.E. THE COMMANDER-IN-CHIEF.
To be Surgeon.

Capt. A. B. H. Bridges, Royal Army Medical Corps, dated October 1, 1916.

War Office,
June 14, 1917.

His Majesty the King has been graciously pleased to approve of the undermentioned reward for gallantry and meritorious service on the occasion of the mining of a hospital ship :—

AWARDED THE DISTINGUISHED SERVICE ORDER.

Major Robert Thornton Meadows, Royal Army Medical Corps.

War Office,
June 18, 1917.

His Majesty the King has been graciously pleased to approve of the appointments of the undermentioned Officers to be Companions of the Distinguished Service Order in recognition of their gallantry and devotion to duty in the Field :—

Capt. Ernest Stanley Stork, M.B., Royal Army Medical Corps, attached Yeomanry.

For conspicuous gallantry and devotion to duty. He displayed untiring energy and devotion to duty in evacuating a large number of wounded under heavy fire. He set a magnificent example of courage and determination.

Capt. (Temp. Major) Alfred Charles Foster Turner, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He attended wounded under heavy fire day and night without rest. He was ever present along the line from the A.D.S. to the most advanced trenches, and on several occasions faced enemy artillery barrages in order that reserves of stretcher-bearers might reach their objectives.

Capt. William Ferguson Wood, M.B., Royal Army Medical Corps, Special Reserve, attached Hussars.

For conspicuous gallantry and devotion to duty. Under most trying circumstances and heavy fire he collected and tended the wounded without rest or food. He frequently made dangerous tours looking for wounded men.

His Majesty the King has been graciously pleased to award a Bar to the Military Cross to the undermentioned Officer:—

Capt. James Alwin Colville Scott, M.C., M.B., Royal Army Medical Corps, attached Durham Light Infantry.

For conspicuous gallantry and devotion to duty. He behaved with great courage and coolness in attending the wounded under heavy shell fire. For two days he worked continuously, with an utter disregard for his own safety. By his efforts he was able to ensure the rapid evacuation of the wounded, and undoubtedly saved many lives. (M.C. gazetted January 1, 1917.)

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers in recognition of their gallantry and devotion to duty in the Field:—

Temp. Capt. Vincent Edgar Badcock, M.D., Royal Army Medical Corps (attached Highland Light Infantry).

For conspicuous gallantry and devotion to duty. He has behaved in a most gallant manner on several occasions in attending to wounded under intense shell fire, showing an utter disregard of personal danger, and setting a splendid example to all.

Temp. Capt. James Harding Barry, Royal Army Medical Corps (attached London Regiment).

For conspicuous gallantry and devotion to duty. He showed the utmost coolness and bravery in going out under heavy machine-gun fire, and assisting to bring in and attend wounded men. Throughout he set a splendid example to all.

Temp. Capt. Bertram Henry Barton, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked continuously under very heavy fire, and succeeded in bringing in many wounded men. His devotion to duty saved many lives.

Temp. Capt. Eric Biddle, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He showed great gallantry in supervising the removal of wounded from a heavily shelled area. By his untiring energy and disregard of personal danger he saved many lives.

Capt. Richard Thompson Caesar, M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. On taking over the line, the cellars of the village were full of wounded. He proceeded with bearers to search all cellars and organized removal of patients. Although the shelling was heavy and practically continuous, he remained all day and succeeded in clearing the village of all wounded.

Temp. Capt. John Donal Carroll, M.B., Royal Army Medical Corps (attached Royal Warwickshire Regiment).

For conspicuous gallantry and devotion to duty. An observation post had been hit, he immediately went to the spot and attended the wounded, although the enemy continued to concentrate heavy shell fire on the post.

Temp. Capt. James Alphonsus Conway, M.D., Royal Army Medical Corps (attached Oxford and Bucks Light Infantry).

For conspicuous gallantry and devotion to duty. He worked indefatigably under heavy fire, and by his personal attention saved the lives of a number of men. He set a fine example to all ranks.

*Temp. Lieut. A. Yeshwant Dabholkar, Indian Medical Service.

For conspicuous gallantry and devotion to duty. Although himself wounded, he displayed great courage and determination in tending wounded men under heavy fire. He set a splendid example to those around him.

*Temp. Lieut. Erach Ruttonji Daboo, Indian Medical Service.

For conspicuous gallantry and devotion to duty. He went forward at great personal risk and dressed many wounded men under very heavy fire. He was himself wounded.

Temp. Capt. Oswald John Daly, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked continuously under very heavy fire, and was responsible for the evacuation of a large number of wounded.

Capt. Walter Elliot Elliot, M.B., Royal Army Medical Corps, Special Reserve (attached Devons.).

For conspicuous gallantry and devotion to duty. He worked continuously throughout the night tending the wounded under heavy fire. His devotion to duty saved many lives.

Capt. Henry William Evans, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He showed the utmost bravery and zeal when commanding a stretcher-bearer division. He directed the bearers and tended the wounded in the open. By his exertions he secured the efficient clearing of the wounded over very long distances.

Capt. Alfred George Timbrell Fisher, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. The advanced dressing station of which he was in command was destroyed by shell fire, and although himself severely shaken, he succeeded in forming a fresh dressing station.

Temp. Capt. Frederick George Flood, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He displayed great courage and determination in tending the wounded under very heavy fire. His disregard of personal danger inspired all ranks. He has previously done fine work.

Capt. Arthur Stuart Hebblethwaite, M.B., Royal Army Medical Corps (attached London Regiment).

For conspicuous gallantry and devotion to duty. He organized and trained a detachment of stretcher-bearers and supervised their operations under heavy fire. All casualties were cleared within a short time of the completion of the operations. This was due to the excellent training and example set by this officer.

Temp. Capt. Daniel Kennedy, Royal Army Medical Corps, attached Lancers.

For conspicuous gallantry and devotion to duty. He tended the wounded under very heavy machine-gun shell fire, to which he was continuously exposed. It is owing to his bravery and untiring devotion that many lives were saved.

*Temp. Capt. John Low, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He brought forward his Bearer Subdivision and established a dressing station under heavy fire, thereby relieving the regimental aid posts. He worked continuously for thirty-six hours.

Capt. Gilbert Moore, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He was in command of the evacuation of the wounded for several weeks on an advanced front. He displayed skill in working his dispositions and personally superintended the evacuation under heavy shell fire.

Capt. William Fraser Munro, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked continuously for forty-eight hours under very heavy fire, and was responsible for the evacuation of a large number of wounded. He set a splendid example to all ranks.

Capt. John Dover Proud, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He worked continuously for forty-eight hours under heavy fire and succeeded in bringing in many wounded men.

Temp. Capt. Arthur Wilmot Raymond, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He organized and led a rescue party to dig out some men partially buried by the explosion of a shell in a captured enemy gun pit. He set a splendid example of courage and determination.

Temp. Capt. Arthur Paul Saint, Royal Army Medical Corps, attached King's Royal Rifle Corps.

For conspicuous gallantry and devotion to duty. He displayed great courage and determination in tending the wounded under heavy fire. His devotion to duty saved many lives.

Temp. Capt. Humphrey Meigh Stephenson, Royal Army Medical Corps, attached Rifle Brigade.

For conspicuous gallantry and devotion to duty. He tended the wounded under heavy fire, and showed a complete disregard for his personal safety. He set a magnificent example throughout.

Temp. Capt. James Williamson Tocher, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He displayed great courage and determination in attending to wounded for many hours during an intense hostile bombardment. He set a fine example to all ranks.

Temp. Capt. Frank Muir Walker, M.B., Royal Army Medical Corps, attached Royal Horse Artillery (Lieut. Canadian Army Medical Corps).

For conspicuous gallantry and devotion to duty. He has displayed the utmost gallantry and devotion to duty when under heavy fire: particularly when he went through a heavy barrage to some wounded men, and tended them in the open for an hour.

Temp. Capt. Thomas Arnold Watson, M.D., Royal Army Medical Corps, attached King's Royal Rifle Corps.

For conspicuous gallantry and devotion to duty. He displayed great courage and determination in tending the wounded under heavy fire. His devotion to duty saved many lives.

Capt. Charles Owen James Young, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He went out under heavy shell fire and attended several wounded men in the open. He has on previous occasions shown fine disregard of personal danger in the face of heavy fire.

Australian Imperial Force.

Capt. William Robert Aspinall, Army Medical Corps, attached Field Artillery.

For conspicuous gallantry and devotion to duty. He displayed the utmost courage and devotion in tending the wounded under heavy fire, assisting them to places of safety until they could be evacuated. He showed the greatest gallantry throughout.

Capt. Ronald Lennox Henderson, Australian Army Medical Corps, attached Infantry.

For conspicuous gallantry and devotion to duty. He displayed great courage and determination in tending the wounded under very heavy fire. His devotion to duty saved many lives.

Capt. William Duncan Kirkland, Australian Army Medical Corps, attached Field Artillery.

For conspicuous gallantry and devotion to duty. During hostile shelling two ammunition dumps were set on fire, also causing several casualties. He immediately went to the assistance of the wounded, and, regardless of heavy shell fire and numerous explosions, dressed their wounds. He has at all times set a fine example.

Capt. Stanley Vincent O'Regen, Army Medical Corps, attached Infantry.

For conspicuous gallantry and devotion to duty. He worked continuously throughout the day tending to the wounded under very heavy fire. He set a fine example to all ranks.

Capt. Hugh Alexander Wyllie, Australian Army Medical Corps, attached Infantry.

For conspicuous gallantry and devotion to duty. He tended the wounded continuously for two days under heavy fire. He set a splendid example of courage and determination.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Distinguished Conduct Medals of the undermentioned Non-commissioned Officer:—

No. 31318 Serjt. W. D. Watson, Royal Army Medical Corps,

For conspicuous gallantry and devotion to duty. He displayed great courage and determination in tending the wounded under heavy fire. He set a fine example to all ranks.

The undermentioned Officers, who were granted rewards in the Honours *Gazette* of the 4th instant, are now correctly described:—

Lieut.-Col. Chester Fish McGuffin, D.S.O., Canadian Army Medical Corps.

Temp. Capt. James Robertson Mitchell, M.C., M.B., Royal Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officers:—

No. 37787 Serjt. J. Smith, Royal Army Medical Corps. (M.M. gazetted December 9, 1916.)

No. 68875 Pte. (Lance-Cpl.) H. Storry, Royal Army Medical Corps. (M.M. gazetted February 19, 1917.)

His Majesty the King has been graciously pleased to award the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men:—

No. 40414 Pte. H. Bargery, Royal Army Medical Corps.
No. 32146 Pte. J. Birse, Royal Army Medical Corps.
No. 27821 Serjt. A. Blandford, Royal Army Medical Corps.
No. 64436 Pte. J. J. Bonnar, Royal Army Medical Corps.
No. 57701 Pte. R. Bristow, Royal Army Medical Corps.
No. 39894 Pte. (Acting-Lance-Cpl.) G. W. Brown, Royal Army Medical Corps.
No. 31776 Pte. G. A. Burkhardt, Royal Army Medical Corps.
No. 70709 Pte. D. P. Bush, Royal Army Medical Corps.

No. 49245 Pte. H. Carrington, Royal Army Medical Corps.
No. 31212 Pte. F. G. Chalke, Royal Army Medical Corps.
No. 45554 Pte. S. Cooper, Royal Army Medical Corps.
No. 29005 Pte. F. M. Clark, Royal Army Medical Corps.
No. 62599 Pte. J. H. Clayton, Royal Army Medical Corps.
No. 439332 Pte. C. L. Davis, Royal Army Medical Corps.
No. 39413 Pte. L. Doody, Royal Army Medical Corps.
No. 67100 Pte. (Lance-Cpl.) J. R. Duckworth, Royal Army Medical Corps.
No. 33680 Cpl. (Acting-Serjt.) S. Dyer, Royal Army Medical Corps.
No. 32082 Pte. F. T. Edmondston, Royal Army Medical Corps.
No. 47455 Pte. H. G. Fulljames, Royal Army Medical Corps.
No. 60979 Pte. A. Greenwood, Royal Army Medical Corps.
No. 65457 Cpl. (Acting Serjt.) B. W. Gunn, Royal Army Medical Corps.
No. 512270 Serjt. G. K. Harkness, Royal Army Medical Corps (formerly 368).
No. 508232 Cpl. H. R. Hathaway, Royal Army Medical Corps (formerly 285).
No. 279 Lance-Cpl. E. Hirst, Royal Army Medical Corps.
No. 74520 Pte. T. Hughes, Royal Army Medical Corps.
No. 32337 Pte. T. J. Johnstone, Royal Army Medical Corps.
No. 46735 Pte. J. Joughin, Royal Army Medical Corps.
No. 65429 Staff-Serjt. A. W. Judd, Royal Army Medical Corps.
No. 58163 Cpl. (Acting-Serjt.) D. Keenan, Royal Army Medical Corps.
No. 339197 Serjt. F. King, Royal Army Medical Corps.
No. 62507 Pte. M. Lalor, Royal Army Medical Corps.
No. 38844 Serjt. G. H. Long, Royal Army Medical Corps.
No. 38863 Pte. J. Marsh, Royal Army Medical Corps.
No. 35467 Pte. M. McCreary, Royal Army Medical Corps.
No. 33479 Cpl. J. J. McGivern, Royal Army Medical Corps.
No. 44887 Pte. T. W. H. Newby, Royal Army Medical Corps.
No. 34844 Serjt. R. W. Nicol, Royal Army Medical Corps.
No. 67028 Serjt. W. Ogden, Royal Army Medical Corps.
No. 31278 Pte. P. Oxford, Royal Army Medical Corps.
No. 39575 Pte. T. Painter, Royal Army Medical Corps.
No. 1556 Pte. J. W. Palmer, Royal Army Medical Corps.
No. 30499 Cpl. A. Rabbage, Royal Army Medical Corps.
No. 73506 Pte. J. S. Randall, Royal Army Medical Corps.
No. 43975 Pte. G. Rawnsley, Royal Army Medical Corps.
No. 49644 Cpl. (Acting Serjt.) J. Rigby, Royal Army Medical Corps.
No. 51167 Pte. P. Rooney, Royal Army Medical Corps.
No. 439419 Pte. J. S. Russell, Royal Army Medical Corps.
No. 53126 Pte. E. A. Ryder, Royal Army Medical Corps.
No. 439278 Pte. R. W. Sainbury, Royal Army Medical Corps.
No. 369429 Cpl. E. Sheel, Royal Army Medical Corps.
No. 536144 Pte. F. A. Smeed, Royal Army Medical Corps.
No. 46296 Pte. H. P. Stansfield, Royal Army Medical Corps.
No. 31072 Lieut.-Col. J. W. Sunter, Royal Army Medical Corps.
No. 510181 Pte. S. J. Turner, Royal Army Medical Corps (formerly 254).
No. 36355 Cpl. (Acting Serjt.) H. Ullyatt, Royal Army Medical Corps.
No. 439042 Lance-Cpl. J. H. Upton, Royal Army Medical Corps.
No. 68894 Pte. W. G. Uttley, Royal Army Medical Corps.
No. 47470 Pte. H. Wackett, Royal Army Medical Corps.
No. 439050 Pte. W. E. Ward, Royal Army Medical Corps.
No. 30385 Serjt. G. Watson, late Royal Army Medical Corps.
No. 46283 Pte. H. Wincup, Royal Army Medical Corps.
No. 66301 Cpl. (Acting-Serjt.) J. Woodhall, Royal Army Medical Corps.

His Majesty the King has been graciously pleased to award the Meritorious Service Medal to the undermentioned Warrant Officers, Non-commissioned Offiers and Men in recognition of valuable services rendered with the Armies in the Field during the present War :—

No. 388163 Staff-Serjt. J. R. Ellison, Royal Army Medical Corps.
No. 17910 Serjt. W. Green, Royal Army Medical Corps.
No. 11952 Qmr.-Serjt. A. E. Malley, Royal Army Medical Corps.
No. 11027 Serjt.-Major J. H. Masters, Royal Army Medical Corps.
No. 16573 Serjt.-Major R. S. Nicol, Royal Army Medical Corps.
No. 57424 Serjt. F. A. Wood, Royal Army Medical Corps.

Whitehall,
June 16, 1917.

The King was pleased, on Wednesday, the 13th instant, to confer the honour of Knighthood upon the undermentioned gentlemen at Buckingham Palace:—

(To take effect as from February 21, 1917.)

Col. Thomas Kennedy Dalziel, Royal Army Medical Corps.

Lieut.-Col. Robert Jones, C.B., F.R.C.S., Lecturer on Orthopædic Surgery at Liverpool University.

War Office,
July 6, 1917.

The Secretary of State for War has received the following dispatches from General Sir Archibald Murray, G.C.M.G., K.C.B., Commander-in-Chief, Egyptian Expeditionary Force:—

General Headquarters,
Egyptian Expeditionary Force,
March 1, 1917.

General Headquarters,
March 18, 1917.

My Lord,—In accordance with the final paragraph of my dispatch dated March 1, 1917, I have the honour to enclose herewith a list of those officers, non-commissioned officers and men, and of other persons, whose names I desire to bring to your notice for gallant or distinguished conduct in the field, or for other valuable services.

I have the honour to be,
Your Lordship's obedient servant,
(Signed) A. J. Murray, *General,*
Commander-in-Chief, Egyptian
Expeditionary Force.

Major H. V. Bagshawe, D.S.O., Royal Army Medical Corps.
Major R. H. Bridges, Royal Army Medical Corps.
Capt. G. Dalziel, M.B., Royal Army Medical Corps. Special Reserve.
Lieut.-Col. E. J. R. Evatt, M.B., Royal Army Medical Corps.
Capt. A. S. M. Macgregor, M.D., Royal Army Medical Corps (Territorial Force).
Col. C. J. MacDonald, M.D., Army Medical Service.
Col. (Temp. Surg.-Gen.) J. Maher, C.B., Army Medical Service.
Lieut.-Col. (Temp. Col.) O. L. Robinson, C.M.G., Royal Army Medical Corps.
Col. M. J. Sexton, C.B., M.D., Army Medical Service.
Major G. C. Taylor, M.D., Royal Army Medical Corps.

Royal Army Medical Corps.

Temp. Capt. P. H. Bahr, M.D.
Temp. Lieut. F. J. H. Begg, M.B.
Capt. (Temp. Major) O. C. P. Cooke.
Temp. Lieut. F. W. Davidson, M.B.
Temp. Qmr. and Hon. Lieut. W. Deans.
Temp. Major A. R. Ferguson, M.D.
Major (Temp. Lieut.-Col.) R. B. Hole, M.B.
Lieut.-Col. A. Hosie, M.D. (retired).
Temp. Lieut. A. E. Harrisson.
Temp. Capt. H. V. Leigh, M.B.
Temp. Capt. R. B. F. McKail, M.B.
Temp. Capt. F. J. McGlade, M.B.
Qmr. and Hon. Lieut. H. W. Rose.
Lieut.-Col. G. Scott, M.B. (retired).
Temp. Capt. H. P. Sheppard, M.B.
Temp. Capt. H. E. S. Stiven, M.D.
Capt. W. W. Treves, M.B., F.R.C.S.
No. 11074 Staff-Serjt. A. J. Daintree.
No. 15183 Staff-Serjt. C. Dewhurst.
No. 4389 Serjt. (acting Staff-Serjt.) P. F. Dedow.
No. 36573 Pte. G. E. Darby.
No. 36409 Serjt.-Major F. Graham.
No. 18634 Staff-Serjt. F. H. Galton.
No. 59802 Pte. (Acting Staff-Serjt.) A. Hilton.

No. 5157 Serjt. S. W. Hobday.
No. 36139 Qmr. Serjt. T. Heald.
No. 26508 Serjt. R. Jamieson.
No. 6262 Pte. (Acting Cpl.) E. H. J. Lovegrove.
No. 12023 Serjt.-Major S. C. Morris.
No. 44450 Staff-Serjt. G. S. Moorhouse.
No. 62114 Pte. F. C. North.
No. 14609 Qmr.-Serjt. (Acting Serjt.-Major) W. P. Oldridge.
No. 15808 Serjt.-Major C. Primer.
No. 12510 Qmr.-Serjt. (Acting Serjt.-Major) F. J. Redwood.
No. 25662 Serjt.-Major F. J. Smith.
No. 55024 Cpl. (Acting Serjt.-Major) H. B. Smith.
No. 5806 Cpl. (Acting Serjt.) E. S. Stevens.
No. 4697 Cpl. (Acting Staff-Serjt) J. H. Tucker.
No. 17022 Staff.-Serjt. (Acting Serjt.-Major) A. R. Weaver.
No. 62228 Serjt. S. E. White.
No. 7017 Pte. (Acting Serjt.) W. Wilkinson.
No. 56808 Pte. J. Younie.
Capt. P. S. Vickerman, M.B.
Capt. T. Young, M.B.
Capt. (Temp. Major) J. Aitken, M.B.
Capt. J. A. Aitken, M.B.
Capt J. A. H. Aitken, M.B.
Capt. C. H. Allen. M.B., F.R.C.S.
Capt. L. B. Baird.
Capt. F. S. Bedale, M.B.
Capt. M. Brennan, M.B.
Capt. A. E. Bullock, M.B.
Major (Temp. Lieut.-Col.) M. Dunning, M.B.
Capt. J. Davidson.
Capt. H. R. Dive.
Major (Temp. Lieut.-Col.) J. Evans, M.D.
Capt. A. A. Gunn, M.B.
Capt. W. T. Gardiner, M.B., F.R.C.S.
Capt. (Temp. Major) W. W. Greer, M.D., F.R.C.S.
Capt. J. Inglis.
Major C. Kerr, M.B.
Lieut.-Col. E. R. Matthews, M.B.
Capt. W. F. Mackenzie, M.B., F.R.F.P.S.
Capt. A. A. McWhan, M.B.
Capt. W. H. Milligan.
Qmr. and Hon. Lieut. R. S. Mason.
Major (Temp. Lieut.-Col.) H. T. Samuel.
Capt. A. F. B. Shaw, M.D.
Capt. C. F. Searle, M.B.
Lieut.-Col. H. W. Thomson, M.D.
Major (Temp. Lieut.-Col.) G. A. Troup, M.D.
Capt. O. Teichmann.
Capt. W. T. Torrance.
Capt. R. G. Walker, M.B.
Capt. A. P. Watson, M.B., F.R.C.S.
No. 315003 Qmr.-Serjt. A. P. Anderson.
No. 205 Cpl. A. Ashton.
No. 545782 Serjt. W. Blaber.
No. 545889 Cpl. (Acting Serjt.) F. G Blackley.
No. 336 Staff-Serjt. S. A. Dyer.
No. 315070 Pte. L. Eagle.
No. 527337 Staff-Serjt. R. J. Gurney.
No. 266005 Serjt.-Major W. A. Howells.
No. 1836 Pte. A. Hemming.
No. 800 Serjt. (Acting Serjt.-Major) S. G. Jackson.
No. 473298 Serjt. L. A. Knowlson.
No. 320134 Serjt. J. Lamont.
No. 512103 Cpl. K. C. Lindsey.

No. 318003 Staff-Serjt. J. Mack.
No. 364160 Serjt. G. Maguire.
No. 363045 Cpl. A. Moulton.
No. 482 Serjt. R. S. Palmer.
No. 541046 Serjt. W. A. Piggott.
No. 533062 Pte. (Acting Serjt.) W. J. Ralph.
No. 298 Serjt.-Major J. M. Sinclair.
No. 270 Qmr.-Serjt. C. H. Sutherland.
No. 515050 Cpl. (Acting Serjt.) A. W. Simmonds.
No. 318113 Cpl. J. D. Shannon.
No. 316087 Staff-Serjt. W. Thomson.
No. 2007 Serjt. H. S. Whitby.
No. 477117 Staff-Serjt. G. F. Wolfe.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

The Annual General Meeting of subscribers to this Fund was held at the Royal Army Medical College on June 11, 1917, Surgeon-General Sir David Bruce, C.B. F.R.S., in the Chair.

The Minutes of the previous Annual General Meeting were read and confirmed.

The accounts and balance-sheet for the year ended February 28, 1917, were unanimously adopted. [They will be found in the issue of the Corps Journal for May, 1917.]

The Hon. Secretary reported that during the year 1916-17 help had been given to the London and Peshawar messes. The former mess had closed, the payment being on account of various insurances and of pension fund for mess servants. Although no other permanently established mess had applied for a grant, there was, he understood, from various mess Secretaries, every probability of heavy calls on the Fund after the War. During the current year a grant had been made to the Aldershot mess committee for the purpose of maintenance, and help had also been given to the widow and orphans of Mr. George Stacey, for many years a mess servant there and at Netley. The financial state of the Central Fund was very satisfactory. During the year 1916-17. £300 had been invested in Exchequer 5 per cent Bonds, £200 in Exchequer 6 per cent Bonds, and £380 in 5 per cent War Bonds, 1929-47. When conversion has taken place on July 2, 1917, the total holding of the Fund will be £1,136 16s. 9d. War Loan 5 per cent Bonds, 1929-47, and £200 Exchequer 6 per cent Bonds, 1920.

Mr. E. T. Gann was appointed auditor for the current year.

3, *Homefield Road*,
Wimbledon, *S.W.*
June 12, 1917.

J. T. Clapham
(*Captain*),
Hon. Secretary.

NOTICE.

Subscribers to the Central Mess Fund are reminded that they are not liable for joining contributions, nor for those paid those on promotion to permanently established messes at home and in India. These contributions are paid for them by the Central Fund, upon which requisition should be made quarterly by mess Secretaries.

J. T. C.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

This Fund provides annuities of £50 a year (together with any additional benefits which may be available from distribution of surplus) to the widows of subscribers and to their children under 21 years of age. The annual subscription varies according to the ages of husband and wife: e.g., in the case of a husband, aged 30, and wife aged 25, it would amount to £14 18s. 6d.; where husband and wife were both aged 28 it would be £12 19s. 11d. At the outbreak of war an additional war charge of 50 guineas per annum was made, and eligibility for membership was limited to officers on the strength of the Corps on that date.

The death-rate amongst officers of the Corps having been lower in the later stages of the war than was expected the Committee have been able to reduce the extra war charge to one of 25 guineas per annum, in addition to the normal annual subscription

according to scale. It has also been resolved that officers gazetted to permanent commissions in the Corps on January 1, 1917, and up to May 22, 1917, shall be eligible for membership on the above terms. The cases of those who may be gazetted later will be considered as they arise.

The Secretary will be glad to give any further information as to details.

J. T. Clapham
(*Captain*),
Secretary.

3, *Homefield Road*,
Wimbledon, S.W. 19.
May, 1917.

ROYAL ARMY MEDICAL CORPS FUND.

The fifteenth annual meeting of the Royal Army Medical Corps Fund was held at the Royal Army Medical College, on Mond4y, June 11, 1917, Surg.-Gen. Sir D. Bruce, Kt., C.B., F.R.S., presiding, in the absence of the Director-General.

REPORT OF THE COMMITTEE.

In the absence of the Secretary, Lieut.-Col. F. W. H. Davie Harris, Col. E. M. Wilson, C.B., C.M.G., D.S.O., read the annual report as follows:—

The number of annual subscribers has diminished from 1,096 in 1915, to about 984 in 1916; this is accounted for by the fact that no fresh permanent commissions were given until January, 1917, and by the natural wastage by death and resignation.

On the other hand the expenditure is about the same, namely, £500 for each year, and we have increased our holdings in War Loan and Exchequer Bonds by an additional sum of £600, and in February of this year by a further investment of £1,000.

(2) *Band.*—The grant for the band was increased to £325 in 1916 against £138 in 1915. In 1914 the grant was £432.

(3) *Dinner.*—There was no annual dinner held last year.

(4) *Memorials.*—There has been no grant towards memorials during 1916, but it is well to bear in mind that when the time comes for considering this question at the end of the War we shall have over £5,000 invested, a considerable portion of which could be made available for this purpose.

(5) *General Relief.*—Expenditure from this fund was very small during 1916 in consequence of the decision to keep the fund for the relief of soldiers of the Regular Army, applications on behalf of men of the New Army being forwarded to the Prince of Wales Fund to be dealt with.

We have received very handsome donations and subscriptions from Companies at home and Units abroad, amounting to over £2,400, and we have now over £5,000 invested mainly in War Loan and Exchequer Bonds, the interest of which will enable us to make regular grants in future times of peace when the grants from companies fall to the pre-war standard. The maximum grant payable to any applicant during six months was raised from £4 to £6 at a Committee meeting held on July 16, 1916.

(6) *Compassionate School Fund.*—The expenditure under this head was £57 and there remains £241 of the amount originally set aside for the purpose of education.

The question as to whether this separate fund should now be absorbed into the General Relief Fund as a matter of convenience in accounting was discussed last year and postponed. We have enough to complete the education of the children at present in the various schools but if we undertake the education of additional children it would have to be paid for out of the General Relief Fund. Power was granted last year to maintain three children for twelve months, but if a child goes to a school it is generally understood that it is maintained until its education is completed.

(2) The next item on the Agenda was then brought forward, viz., to vote a grant for the General Relief Fund. It was proposed by Col. Tyrrell and seconded by Col. Wilson that a grant of £25 be given from the Royal Army Medical Corps Fund to the General Relief Fund. Carried.

(3) To appoint auditors for the current year. It was proposed by the Chairman and seconded by Surg.-Gen. Sir G. D. Bourke that the present auditors, viz., Surg.-Gen. Jencken and Col. Wilson, be re-elected. Carried.

(4) To consider the following recommendations of the Committee: "That as the General Relief Fund is now on a sound financial basis the time has arrived when it should take its share in the administrative expenses of the fund, therefore the Committee recommend that one-half of the working expenses borne by the Royal Army Medical Corps Fund shall in future be debited to the General Relief Fund."

On the recommendation of the Committee it was proposed that the General Relief

Fund should in future pay one-third of the general working expenses of the Royal Army Medical Corps Fund and the Benevolent Fund. Carried.

The result of this decision will be that in the future the general working expenses of the Royal Army Medical Corps and Benevolent Funds will be divided into three equal portions, of which one-third will be borne by the Benevolent Fund and one-third each by the Royal Army Medical Corps Fund and General Relief Fund.

(5) Compassionate School Fund. It was proposed by Col. H. W. Murray and seconded by Col. Tyrrell that the question of the future of the Compassionate School Fund be postponed to the next general meeting.

(6) On the recommendation of Lieut.-Col. Wilson an additional grant of £6 from the General Relief Fund was authorized for Mr. M. K. Quilan, late Staff-Serjt., R.A.M.C., as a special case.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

PROCEEDINGS OF THE ANNUAL GENERAL MEETING HELD IN THE LIBRARY OF THE ROYAL ARMY MEDICAL COLLEGE, ON MONDAY, JUNE 11, 1917.

Surg.-Gen. Sir David Bruce, Knt., C.B., F.R.S., in the absence of the Director-General A.M.S., presided.

(1) The Minutes of the last annual general meeting were read and confirmed.

(2) The report of the Committee was read as follows—

(i) The number of subscribers for the year was 170 and the amount of subscriptions received was £178 1s.

(ii) A sum of £104 12s. 9d. was received as a rebate of Income Tax.

(iii) A donation of £50 was received from the Medical Insurance Agency, also £5 each from Mrs. A. F. Macbean, and Col. H. H. Norman.

(iv) The total receipts amounted to £920 19s. 7d.

(v) The total expenditure amounted to £1,090 19s. 7d.

(vi) Twenty-seven applicants representing forty-three orphans were granted £725.

It was proposed by Surg.-Gen. Sir G. D. Bourke and seconded by Col. W. T. Martin that the report be approved. Carried.

The accounts for the year 1916 and the Auditor's report were received and adopted.

(3) The grants recommended by the Committee were considered and approved.

(4) The Vice-Presidents, Committee and Auditor were re-elected for the ensuing year.

AUXILIARY ROYAL ARMY MEDICAL CORPS FUNDS.

PROCEEDINGS OF A SPECIAL COMMITTEE MEETING HELD AT 124, VICTORIA STREET, S.W., ON THURSDAY, JUNE 28, 1917.

Present:

Col. Culver James.
Col. Atwood Thorne.
Lieut.-Col. Sir W. W. Cheyne.
Lieut.-Col. C. W. Mansell Moullin.
Lieut.-Col. W. Collier.
Major D. W. Patterson.
Major G. N. Pitt.

In the absence of Major Maclean, Col. Culver James was requested to take the chair.

Letters of apology for absence were read from :—

Major E. J. Maclean, (Chairman), Col. H. G. Barling, Major A. C. Farquharson, Surg.-Gen. Sir A. Bowlby, Surg.-Gen. Sir G. H. Makins, Col. H. H. Tooth, Lieut.-Col. W. Hale White, Lieut.-Col. F. W. Westmacott, Col. D. J. Macintosh, Lieut.-Col. Sir W. Osler.

The Minutes of the last Meeting were read, but their confirmation was postponed until the regular meeting in July.

The Chairman reported the death of the Secretary, Lieut.-Col. Harris, on June 20, and that the funeral had been attended by Lieut.-Col. E. M. Wilson, who presented a wreath on behalf of the Committee.

The Committee directed that a letter of condolence should be sent to Mrs. Harris, the widow, with an expression of appreciation of her husband's service as Secretary in the institution and development of the Funds, to be signed by the Chairman and Secretary.

Lieut.-Col. E. M. Wilson was appointed Secretary from the date of Lieut.-Col. Harris's death, June 20, until the end of the year 1917, under the same conditions as the late Secretary.

The cases of two applicants for assistance from the Benevolent Branch, on account of orphans, were considered, and the Secretary was directed to deal with them under Rule 33; also one application for assistance from the General Relief Branch which was directed to be dealt with under Rule 9, the amount of the donation being limited to £4, to be issued in monthly instalments of £1 each.

The Secretary reported that £1,000 5 per cent. Exchequer Bonds 1920 had been converted into £1,052 12s. 6d. 5 per cent War Stock, and asked for instructions as to making the odd amount of stock up to the next multiple of £50 by the purchase of additional stock in the market. After consultation with Sir W. W. Cheyne, who is one of the Trustees, the Committee approved of this being done, and directed the Secretary to take the necessary action.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT THE WAR OFFICE, ADASTRAL HOUSE ROOM, ON TUESDAY, JULY 10, 1917.

Present:

Surg.-Gen. M. W. Russell, C.B., D.D.G., A.M.S., in the Chair.
Col. C. R. Tyrrell, C.B.
Col. W. H. Horrocks, C.B., K.H.S.
Major Sir E. S. Worthington, C.M.G., M.V.O.

(1) A letter of apology for non-attendance was read from Surg.-Gen. Sir David Bruce.

(2) The Minutes of the last meeting, held on April 12, were read and confirmed.

(3) Lieut.-Col. E. M. Wilson (acting Secretary) reported the death of the Secretary, Lieut.-Col. F. W. H. Davie Harris, on June 20, also that he attended the funeral on June 23, and presented a wreath on behalf of this Fund and the Royal Army Medical Corps Benevolent Society.

(4) The purchase of the wreath was approved, and it was resolved to send a letter of condolence to Mrs. Harris.

(5) Proposed by Col. C. R. Tyrrell, and seconded by Major Sir E. S. Worthington, that Lieut.-Col. E. M. Wilson be appointed Secretary for one year from June 20, 1917, under the same conditions as the late Secretary. Carried.

(6) The Secretary reported the grant of £2 from the General Relief Fund to an urgent case. Approved.

(7) A grant of £1 to the Royal Army Medical Corps Auxiliary Fund towards the cost of a telephone installed by that Fund, and used by all the Funds was approved.

(8) The question of auditing the accounts was considered consequent on the appointment as Secretary of Lieut.-Col. Wilson, who is one of the auditors, and it was proposed by Col. C. R. Tyrrell, and seconded by Col. Horrocks, that a professional auditor should be appointed for this year subject as regards future years to the approval of the next Annual General Meeting. Carried.

(9) The Secretary was directed to inquire if Messrs. Evans, Pierson and Co., who audit the accounts of the Benevolent Society, will undertake this service.

(10) Proposed by Col. Horrocks, and seconded by Major Sir E. S. Worthington, that Col. Sir J. Magill and Lieut.-Colonel Cottell be asked to join the Committee in place of Colonel Sir J. R. A. Clarke and Lieut.-Col. E. M. Wilson. Carried.

(11) The grant of £100 to the Band authorized by the Committee at its meeting on April 12, was directed to be paid.

(12) The purchase of additional stock, £26 6s. 6d., to make up the existing amount of £1,472 13s. 6d. 5 per cent War Loan to the next multiple £50, was approved, and the Secretary directed to carry out the necessary transaction.

(13) The question was considered of appointing special Trustees by name for the Investments of the Royal Army Medical Corps Fund, as has already been done in the case of Investments of the General Relief Fund, and the Secretary was directed to make inquiries as to the cost, and also whether the Public Trustee would accept the position, and report to the next meeting.

(14) The payment of 10s. 6d. for repairs to office furniture was approved.

ROYAL ARMY MEDICAL CORPS BENEVOLENT SOCIETY.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT ADASTRAL HOUSE, WAR OFFICE, ROOM 313, ON TUESDAY, JULY 10, 1917.

Present.

Surg.-Gen. M. W. Russell, C.B., Vice-President, in the Chair.
Surg.-Gen. Sir W. Donovan, K.C.B.
Lieut.-Col. A. B. Cottell.

(1) A letter of apology for non-attendance was read from Col. J. Lane Notter.

(2) The Minutes of the last meeting held on April 12, were read and confirmed.

(3) Lieut.-Col. E. M. Wilson (acting Secretary) reported the death of the Secretary, Lieut.-Col. F. W. H. Davie Harris on June 20, also that he had attended the funeral on June 23 and presented a wreath on behalf of the Society and the Royal Army Medical Corps Fund.

(4) The purchase of the wreath was approved and it was decided to send a letter of condolence to Mrs. Harris.

(5) Proposed by Surg.-Gen. Sir W. Donovan and seconded by Lieut.-Col. A. B. Cottell that Lieut.-Col. E. M. Wilson be appointed Secretary from June 20, 1917, for one year under the same conditions as the late Secretary. Carried.

(6) The Secretary reported the grant of £10 to an applicant under Rule 31, as an urgent case. Approved.

(7) A grant of £1 to the Royal Army Medical Corps Auxiliary Fund towards the cost of a telephone installed by that Fund and used by all Funds was approved.

(8) It was resolved that additional Stock be purchased to make up the present holding of £210 10s. 6d. 5 per cent War Loan to the next multiple of £50 if money is available.

(9) It was resolved that Capt. J. T. Clapham, R.P. be asked to join the Committee in place of Lieut.-Col. Wilson appointed Secretary.

(10) The Secretary was directed to make inquiries as to the cost of reprinting the Rules of the Society and List of Members, and report to the next meeting.

AUXILIARY ROYAL ARMY MEDICAL CORPS FUNDS.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT 124, VICTORIA STREET, S.W., ON THURSDAY, JULY, 19, 1917.

Present.

Major Ewen Maclean, Chairman.
Col. W. Culver James.
Col. W. Macintosh.
Lieut.-Col. S. W. Osler.
Lieut.-Col. W. Collier.
Lieut.-Col. C. W. Mansell Moullin.
Major G. Newton Pitt.
Major D. W. Patterson.
Capt. R. Johnston Stirling.

(1) The Minutes of the meetings held on April 19 and June 28 were read and confirmed.

(2) A letter of acknowledgement was read from Mrs. Harris thanking the Committee for their kind sympathy on the death of her husband.

(3) The Secretary reported the action taken in two cases of application to the Benevolent Branch under Rule 33, and of one case to the Relief Branch under Rule 9. Approved.

(4) The Secretary reported action taken to purchase additional stock £21 1s. 3d. to make up the present holding of 5 per cent War Loan to the next multiple of £50. Approved.

(5) The Secretary read correspondence with Messrs. Holt and Co., relative to the separation of the accounts of the Benevolent and Relief Branches, and after discussion the Resolution prepared by Messrs. Holt and Co. to carry this into effect was approved as a Resolution of the Committee, and the chairman was authorized to sign, provided that no action should be taken until first it was definitely decided that the sum of £7,100 already invested actually belongs in two equal shares of £3,550 each to the

Benevolent Branch and the Relief Branch ; second, that the amount now standing in the current account be accurately divided between the two branches according to the intentions of the donors.

For this purpose the Secretary was empowered to obtain skilled financial assistance and pay charges up to the extent of £2 2s., the present Ledger to be closed and the two branches to be kept in future entirely distinct both as regards investments and current accounts.

(6) Proposed by Col. Culver James and seconded by Sir W. Osler that all donations shall be invested. Carried.

(7) It was also agreed that as large a proportion of the current acconnt of each branch shall be invested from time to time in 5 per cent War Loan subject to a reasonable margin being kept. The sum proposed being £150 in each current account.

(8) The Secretary reported receipt of dividends amounting, with interest on deposit, to 106 15s. 1d., also donations and subscriptions as per lists attached, and was directed to forward list of donations of £3 3s. and upwards to the *Lancet* and *British Medical Journal* for publication.

(9) The date of the next Committee meeting and also of the Annual General Meeting was fixed for Friday, October 16, the former at 11 a.m. and the latter at 3 p.m.

(10) The Secretary reported the grant of £2 from the Royal Army Medical Corps Fund towards cost of telephone. Noted.

(11) The question was discussed of granting relief from the Benevolent Branch to the Orphans of Officers more frequently than once a year at the Annual General Meeting, and it was decided to draft a resolution for the consideration of the next Committee meeting on October 26, with a view of submitting it to the General Meeting if approved.

(12) Proposed by Lieut.-Col. Collier and seconded by Lieut.-Col. Patterson that a small sub-committee be appointed to inquire into and advise as to the future administrative expenses of the Royal Army Medical Corps Auxiliary Funds. Carried.

The following were appointed to the sub-committees.

The Chairman : Lieut.-Col. W. Collier.

One of the Trustees : W. Hale White.

(13) The need was discussed of bringing the existence and objects of the Funds more widely to the notice of Officers commanding units at home and abroad with a view of increasing the numbers of subscribers, and the Chairman undertook to consult the Director-General personally on the matter, and was empowered by the Committee to take action in accordance with Sir Alfred Keogh's advice.

(14) The Chairman read correspondence which had taken place with the London County Council regarding the registration of the Funds under the War Charities Act, 1916, and it was agreed that the Funds should be registered, the necessary information supplied, and the required forms completed.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

Summary of the Proceedings of the One Hundred and Second Annual General Meeting of Members which was held at the Royal Army Medical College on May 22, 1917.

Surg.-Gen. M. W. Russell, C.B., Deputy Director-Gen., in the Chair.

The Minutes of the Annual and Special General Meetings held on May 26, 1916, were read and confirmed.

The accounts, balance sheet and report for the year, 1916, were examined and unanimously adopted.

Messrs. Deloitte and Co. were appointed auditors for the year 1917.

The following Members of the Committee retired at the expiration of their three years of office :—

Surg.-Gen. Sir H. R. Whitehead, K.C.B.
Col. Sir M. P. C. Holt, K.C.M.G, C.B., D.S.O.
Col. T. W. Gibbard, K.H.S.
Lieut.-Col. E. T. F. Birrell, C.B., C.M.G.
Lieut.-Col. R. S. H. Fahr, C.M.G., D.S.O.

And in their place the undermentioned were elected :—

Lieut.-Col. R. J. L. Fayle, D.S.O.
Lieut.-Col. G. S. Mansfield.
Major P. S. O'Reilly, C.M.G.
Capt. W. C. Smales, D.S.O.
Capt. W. F. M. Loughnan, M.C.

A vote of thanks was unanimously passed to the Secretary for his zeal and energy in the interests of the Society. He having explained that he was much indebted to the Consulting Actuary, Mr. Andres, for help and advice, it was resolved that the latter be associated with the Secretary in the vote of thanks.

SUMMARY OF THE PROCEEDINGS OF A SPECIAL MEETING OF THE COMMITTEE HELD ON MAY 22, 1917.

Present:

Deputy Surg.-Gen. W. G. Don, Vice-President in the chair.
Surg.-Gen. W. S. M. Price, Vice-President.
Lieut.-Col. J. Stevenson.
Lieut.-Col. J. More Reid.
Major P. S. O'Reilly, C.M.G.

The Minutes of the quarterly meeting held on April 17 were read and confirmed.

The Secretary reported that, as directed at the last meeting, he had made inquiry as to the various details concerning the 111 officers gazetted to permanent commissions on January 1, 1917, and had submitted the results to the actuary, who had replied in a letter which was laid before the meeting. After considering this report it was unanimously resolved that officers who were gazetted to permanent positions in the Corps on January 1, 1917, and up to the date of this meeting, be eligible for membership at the reduced extra war charge of 25 guineas per annum, in addition to the normal annual subscription according to scale. The Committee reserves the right of increasing this war charge, if need be, to applicants for membership who may be commissioned later than the above date, and also of closing the Society to new entrants at any time, should an exceptionally adverse mortality render such a course desirable.

The Secretary reported that the first payment of interest on 5 per cent war stock was due on June 1, and requested authority to invest a part of it. It was resolved unanimously that the Secretary be authorized to take the steps necessary to invest any available surplus from cash balance at the bankers, not exceeding £1,000, in either 5 per cent War Loan, 5 per cent Exchequer Bonds, or various Australian Government Securities, as the Actuary might advise, subject to the approval of the Trustees.

3, *Homefield Road,* J. T. CLAPHAM, *Captain,*
Wimbledon, S.W. 19. *Secretary.*

THE LATE MR. GEORGE STACEY.

MANY officers in the Corps will learn with genuine regret of the death of Mr. George Stacey, from heart failure, at Aldershot, on April 22, aged 54.

As Lance-Corporal Stacey he served 7 years 231 days with the 87th Royal Irish Fusiliers. On his discharge from the Army twenty-six years ago he became a mess waiter and valet at the Officers' Mess, Netley, where he remained for fourteen years, and was then transferred in the same capacity to the Officers' Mess, McGregor Barracks, Aldershot, where for the past twelve years he has been employed.

Mr. Stacey was highly respected and trusted by all the officers who have had the good fortune to be served by him. The interests of those who employed him were always his first care. His character, as also the manner in which he fulfilled his duties, were beyond reproach. Although his health was not too good of late, yet he was able to continue at work until a very short time ago. His end was peaceful, and he retained complete consciousness until just before he died.

Sincere sympathy will be felt for his widow and family. He leaves a family of four boys and a girl, the two youngest being aged 3 years and 7 months respectively.

Mrs. Stacey is left unprovided for, and it is felt that there are many officers in the Corps who knew Stacey at Netley or at Aldershot who would be glad of an opportunity of showing their appreciation of him by contributing to a fund for the benefit of his widow and family. Major W. A. Ward, Hon. Secretary, R.A.M.C. Officers' Mess, has consented to receive and acknowledge any donations sent to him for this object.

Mrs. Stacey's immediate wants have been very kindly met by the Central Mess Fund, and as contributions come to hand they will be placed on deposit (bearing

interest) with the Aldershot branch of the London County and Westminster Bank. Later it will be decided how the money can best be invested with a view to providing her with a small income.

The following amounts (for the relief of the widow and family of the late George Stacey) have been received by Major W. A. Ward, Hon. Secretary, R.A.M.C. Mess, Aldershot:—

	£	s.	d.		£	s.	d.
Col. L. T. Nash, C.M.G. ..	1	0	0	Capt. L. C. Hayes	0	10	0
Lieut.-Col. J. G. McNaught ..	2	0	0	Capt. F. J. Turner	0	10	0
Lieut.-Col. F. S. Irvine, D.S.O.	1	0	0	Capt. E. A. Allnutt	0	10	0
Lieut.-Col. G. McLaughlin, D.S.O.	0	10	0	Capt. H. Beddingfield	0	10	0
Lieut.-Col. W. R. Blackwell ..	1	0	0	Capt. A. Jackson	0	10	0
Major Maynard Crawford ..	0	10	0	Capt. J. M. Evatt	0	10	0
Major J. P. Lynch	0	10	0	Capt. F. R. Laing	1	0	0
Major J. Fairbairn	0	10	0	Capt. H. Blake	0	10	0
Major C. J. Coppinger	0	10	0	Capt. C. Vere Nicoll (S.R.) ..	0	10	0
Major A. J. Williamson ..	0	10	0				
Major G. A. B. Harvey	0	10	0		£14	10	0
Capt. J. T. Clapham	1	0	0				

Aldershot, May 21, 1917.

Since the above was written Mrs. Stacey has been involved in further trouble in that her eldest daughter, aged 14, who had just left school in order to take up an appointment offered her at the Royal Flying Corps was found, when she went up for her medical examination, to be suffering from heart disease and her medical attendant will only allow her to do the lightest work.

WAR EMERGENCY FUND OF THE ROYAL MEDICAL BENEVOLENT FUND.

To the Editor of the *British Medical Journal.*

Sir,—The time has come to make a further appeal for the War Emergency Fund.

This Fund was instituted last year to afford assistance to members of our profession who, in consequence of having joined the Army Medical Service, find themselves in temporary difficulties.

Many medical men, when called up, had to leave on very short notice, without time to make adequate provision for the continuance and maintenance of their practices during their absence. As a result they have had to face a severe fall in income even when supplemented by Army pay; while many expenses, such as rent, insurance, taxes, family maintenance, and education, could not be reduced. Although in a year or two after their return it may be hoped those affected will recover their position, still in the interval help is, and will be, necessary, and it is to meet these needs that the War Emergency Fund was established.

To be effective the grants must be made on a liberal scale, and the fund from which they are to be drawn must be a large one. The sum obtained last year was about £4,000. This is quite inadequate, as at least £25,000 will be required, if even a small proportion of those requiring assistance is to be helped. From the wealthier members of the medical profession, it is hoped, substantial sums will be received, but everyone should feel it a duty which he owes to his less prosperous colleagues to give the most liberal donation he can afford.

At the same time the appeal is not, and ought not to be, restricted to the medical profession. The public, too, may be rightly called upon to bear its share, and to show, by liberal contributions, its appreciation of the special services so freely rendered by the medical profession to the country.

The War Emergency Fund is a special department of the Royal Medical Benevolent Fund. It is kept separate and distinct from the ordinary operations of the general fund, and is under the management of a committee specially appointed for the purpose.

Communications should be addressed to the Honorary Secretary, War Emergency Fund, 11, Chandos Street, Cavendish Square, W.1, to whom cheques should be made payable.—We are, etc.,

Samuel West, *President.*
Charters J. Symonds, Colonel A.M.S., *Honorary Treasurer.*
G. Newton Pitt, Major R.A.M.C. (T.), *Honorary Secretary.*

*London, W.*1, *June* 8.

CASES OF SPECIAL DISTRESS CAUSED BY THE WAR WHICH THE COMMITTEE HAVE HELPED.

A Lieutenant in the Royal Army Medical Corps, who had only been in practice a few years, volunteered for service, and was killed in action a few days later. He left a widow, with two children, aged 3½ and 1, without means except the War Office pension. The Fund voted £25 for her immediate necessities, and the Officers' Families Fund gave further help.

A Captain in the Territorials was called out, and had to leave his practice in the hands of a locum, who proved a failure. There were seven children aged 2 to 14. Financial difficulties arose, and payment of the school fees became impossible. Between the Fund and Guild, and the Officers' Families Fund, the necessary fees were raised, and sorely needed clothing provided.

A Captain in the Territorials, who was called out when the Army mobilized, and had to leave his practice worth £800 at a day's notice, could not pay the fees for his son's education, who was in his last year at school. The Fund, the Guild, and the Professional Classes War Relief Council together raised the necessary money.

A Captain in the Territorials was killed in action, and left a widow, and two children, aged 3 and 4½. The Fund investigated the case, and referred it to the Officers' Families Fund, who gave her a grant to meet her immediate necessities. The Fund also obtained work for the widow, a trained nurse, who was thus enabled to earn her own living.

A Major, Royal Army Medical Corps, Territorial, was called out at the beginning of the War and was abroad for over two years. He was invalided to England and put on home service. His practice was completly lost by his absence. There are three children, one in the Navy, one in the Army, and one at school. He had to give up his house, as he was in difficulties with rent, taxes and education. The Fund gave £50, and further help was obtained from other sources.

A Captain in the Royal Army Medical Corps, Territorial, with a wife and six children, found the income derived from his practice, left in charge of a locum, and the balance of his Army pay insufficient to meet his expenses. He obtained assistance from the Civil Liabilites Committee and the Officers' Families Fund, and a grant was made from the War Emergency Fund towards the education of the children.

A practitioner, earning £700 to £800, volunteered for service, leaving his practice in the hands of a neighbour, who was not a success. There were two children, aged 7 and 10, and another baby was born shortly after the husband left. The wife contracted pneumonia and nearly died. A resident patient had to leave the house. Rent and other expenses led to a debt of about £80. This the doctor could not meet, and he hurried back from the trenches to save his home from being sold up. The Fund voted £25, the Guild gave £15, the Officers' Families Fund £25, and the Professional Classes War Relief Council offered further help, with the result that he returned to the front with his immediate anxieties relieved.

Sir,—We beg to support the urgent letter of appeal to this Fund which appeared in the last week's medical journals.

This Fund was instituted by the Royal Medical Benevolent Fund last year to afford assistance to members of the profession who, in consequence of having joined the Army Medical Service, find themselves in temporary difficulties.

We very strongly commend the claims of this Fund to the generous support of both the profession and the public.—We are, etc.,

FREDERICK TAYLOR,
President, Royal College of Physicians.
W. WATSON CHEYNE,
President, Royal College of Surgeons.
W. H. NORMAN, Surgeon-General, R.N.
Director-General of the Medical Department of the Navy.
ALFRED H. KEOGH,
Director-General, Army Medical Service.
WILLIAM OSLER,
Regius Professor of Medicine, University of Oxford.
T. CLIFFORD ALLBUTT,
Regius Professor of Physic, University of Cambridge.
JOHN TWEEDY,
Past-President, Royal Medical Benevolent Fund.

11, *Chandos Street,*
Cavendish Square, W.1.
June 16.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF APRIL, MAY AND JUNE, 1917.

Title of Work and Author	Edition	Date	How obtained
Les Formes Anormales du Tétanos. Par Courtis-Suffit et Giroux		1916	Library Grant.
Les Séquelles Ostéo-Articulaires des Plaies de Guerre. Par Aug. Broca		1916	,, ,,
Fièvres Typhoïdes et Para-Typhoïdes. Par H. Vincent et H. Muratet		1916	,, ,,
Dysentéries, Choléra Asiatique et Typhus Exanthématique. Par H. Vincent et H. Muratet		1917	,, ,,
Formes Cliniques des Lésions des Nerfs. Par Mme. Athanassio Benisty		1916	,, ,,
Les Blessures de l'Abdomen. Par J. Abadie ..		1916	,, ,,
Traitement des Fractures. Par R. Leriche. Vol. i.		1916	,, ,,
Sanitation in War. By Major P. S. Lelean, C.B. R.A.M.C.	2nd	1917	,, ,,
The Maintenance of Health in the Tropics. By W. J. Simpson, C.M.G.	2nd	1916	,, ,,
A Practical Guide to X-Rays, Electro-Therapeutics and Radium Therapy. By Major A. C. Walter, I.M.S.		1916	,, ,,
Poisons, their Effects and Detection. By A. Wynter Blyth and M. Wynter Blyth	4th	1906	,, ,,
The Physiology of Food and Economy in Diet. By W. M. Bayliss		1917	,, ,,
Gonorrhœa and its Complications in the Male and Female. By David Watson, M.D.		1914	,, ,,
Food and the Principles of Dietetics. By R. Hutchison, M.D.	4th	1916	,, ,,
Clinical Bacteriology and Hæmatology. By W. d'Este Emery, M.D.	5th	1917	,, ,,
The New Public Health. By H. Winslow Hill ..		1916	,, ,,
Text-book of Nervous Diseases. By C. Dana, M.D.	8th	1916	,, ,,
The Intensive Treatment of Syphilis and Locomotor Ataxia by Aachen Methods. By Reginald Hayes	2nd	1917	,, ,,
A Manual of Practical X-Ray Work. By Arthur and Muir	2nd	1917	,, ,,
Handbook of Physiology. By W. D. Halliburton, M.D.	13th	1917	,, ,,
Epidemics resulting from Wars. By Dr. F. Prinzing. Edited by H. Westergaard		1916	,, ,,
The Gases of the Atmosphere. By Sir W. Ramsay, K.C.B., F.R.S.	4th	1915	,, ,,
A Narrative of the Expedition to Holland in the Autumn of the year 1799. By E. Walsh, M.D.		1800	,, ,,
Letters from Portugal and Spain: comprising an Account of the Operations of the Armies under Sir Arthur Wellesley and Sir John Moore. By Adam Neale, M.D.		1809	,, ,,
A History of the British Army. By the Hon. J. W. Fortescue. Vol. viii, 1811-12		1917	,, ,,
The Year-Book of the Scientific and Learned Societies of Great Britain and Ireland		1916	,, ,,
Report of the Surgeon-General, United States Army		1916	Editor, Journal.

LIST OF BOOKS ADDED TO THE LIBRARY—*Continued.*

Title of Work and Author	Edition	Date	How obtained
The Treatment of Tabetic Ataxia. By Dr. H. S. Frenkel. Revised by L. Freyberger	2nd	1917	Editor, Journal.
Glaucoma. By Lieut.-Col. R. H. Elliot, I.M.S. (Ret.)		1917	,, ,,
Regimental Silhouettes. By Charles Gribble ..		1917	,, ,,
War-Shock. By M. D. Eder		1917	,, ,,
Collected Papers from the Research Laboratory, Parke, Davis and Co. Reprints. Vol. iv		1916	,, ,,
Servicos de Saude Naval em Guerra. Julio Goncalves			
Year-Book of the Royal Society of London ..		1917	Royal Society.
Journal of the Royal Naval Medical Service, April..		1917	The Editor.
Report on the Health of the Army for the year 1913		1917	War Office.
War Office Library Catalogue. Part 3 (Subject Index). 5th Annual Supplement (January to December, 1916). Compiled by F. J. Hudleston		1917	,, ,,
Hand-book of the German Army in War. Issued by the General Staff		1917	,, ,,
The Influence of Vascular Disease in the Retina on the Prognosis as regards Life. (Reprint.) By P. H. Adams, F.R.C.S.		1917	Surg.-Major-General Sir A. F. Bradshaw, K.C.B.
The Lumleian Lectures on Modern Aspects of Heart Disease. (Reprint.) By G. A. Sutherland, M.D.			Surgeon-General, Sir D. Bruce, C.B., F.R.S.
Columbia Alumni News. Vol. viii. Nos. 17, 22 and 23		1917	Lieut.-Col. G. E. Twiss, C.M.G., R.A.M.C.
Index Catalogue of the Library of the Surgeon-General's Office, United States Army. Second Series. Vol. xxi		1916	Surgeon-General, U.S. Army.
The Fauna of British India, including Ceylon and Burma. Coleoptera Lamellicornia. Part ii. Rutelinae. By G. J. Arrow		1917	The Secretary of State for India in Council.
Insecticidal Fumigation of Ships, with special reference to the use of Hydrocyanic Acid and to the Prevention of Ship-borne Yellow Fever. (Reprint.) By C. E. Corbett, M.D.			The Author.
Medical Advisory Committee. Mesopotamia Inquiries			Lieut.-Col. A. Balfour, C.M.G., R.A.M.C.
Report on Basrah Base, September, 1916		1917	
Report as to Sheikh Saad, October, 1916		1917	,, ,,
Report on Lines of Communications (Sheikh Saad to Basrah), November, 1916		1917	,, ,,
Report on Remaining Inspections (Euphrates and Karun), December 20, 1916, to January 12, 1917		1917	,, ,,
Mesopotamia Inquiries (September, 1916, to January, 1917.) Final Report. (With General Index to all Reports)		1917	,, ,,
National Health Insurance. Medical Research Committee:—			
First Annual Report. 1914-1915		1915	The Secretary, Medical Research Committee.
Second Annual Report. 1915-1916		1916	

List of Books added to the Library—*Continued.*

Title of Work and Author	Edition	Date	How obtained
First Report of the Special Investigation Committee upon the Incidence of Phthisis in relation to Occupation. The Boot and Shoe Industry		1915	The Secretary, Medical Research Committee.
Report of the Special Advisory Committee upon Bacteriological Studies of Cerebrospinal Fever during the Epidemic of 1915		1916	,, ,,
Special Report Series. No. 3. Bacteriological Studies in the Pathology and Preventive Control of Cerebrospinal Fever among the Forces during 1915 and 1916		1917	,, ,,
Special Report Series. Nos. 4, 5 and 6. Reports upon Investigations in the United Kingdom of Dysentery Cases received from the Eastern Mediterranean		1917	,, ,,
Special Report Series. No. 8. Report upon Soldiers returned as Cases of "Disordered Action of the Heart" (D.A.H.), or "Valvular Disease of the Heart" (V.D.H.)		1917	,, ,,

Royal Army Medical College,
July 9, 1917.

BIRTH.

DUNKERTON.—At 64, Gauden Road, Clapham, S.W.4, on July 22, 1917, the wife of Lieut-Col. N. E. Dunkerton, R.A.M.C., of a daughter.

MARRIAGE.

SPENCE—MACKENZIE.—The marriage arranged between Capt. Basil Hamilton Hebden Spence, M.B., Royal Army Medical Corps, attached Egyptian Army, eldest son of Mr. T. W. L. Spence, C.B., of Uyea, Uyeasound, Shetland, and Margaret Alice, only daughter of the late George Hunter Mackenzie, M.D., and Mrs. Mackenzie, 44, Inverleith Row, Edinburgh, took place quietly at St. Saviour's Church, Paddington, on May 31.

DEATH.

JONES.—At Nowshera, N.W.F.P., India, on the 14th May, 1917, from cerebral malaria, Major J. Langdale Jones, R.A.M.C. Deeply regretted.

EXCHANGES, &c.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of Excerpts *	Extra for Covers for Reprints: As Journal, Printed on Front	Extra for Covers for Reprints: As Journal, Plain, Unprinted	Extra for Covers for Reprints: Cheaper Paper, Printed on Front	Extra for Covers for Reprints: Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2				
	8	0 5 0	0 2 3	4 3	1 1	3 10	0 9
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5				
	8	0 6 0	0 2 9	4 10	1 6	4 4	0 11
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10				
	8	0 7 6	0 3 6	6 0	2 1	4 10	1 2
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1				
	8	0 10 0	0 4 10	7 10	3 11	6 7	2 5
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5				
	8	0 15 0	0 6 7	10 10	7 6	9 0	4 10
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

CASES FOR BINDING VOLUMES.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. net; binding, 2s.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W.

Communications have been received from Lieutenant-Colonels J. Mackinnon, W. A. Turner; Majors G. Pearson, E. K. Martin; Captains K. Black, P. H. Bahr, A. H. Pirie, A. J. H. Iles, H. J. Norman, G. H. Clark, H. S. Raper, H. F. Marris W. R. H. Heddy, A. F. De Waal, F. W. Watkyn-Thomas, R. L. Scott, J. R. Young, G. F. Petrie, W. Fletcher; G. W. Micklethwait, R. E. Savage.

The following publications have been received:—

British: Proceedings of the Royal Society of Medicine, The Journal of Tropical Medicine and Hygiene, The Hospital, Medical Press and Circular, The Medical Journal of Australia, St. Bartholomew's Hospital Journal, Guy's Hospital Gazette, The Indian Medical Gazette, The Medical Review, Bulletin of Entomological Research, Tropical Diseases Bulletin, Public Health, The Medical Journal of South Africa, The Royal Engineers' Journal, The Practitioner, Tropical Veterinary Bulletin.

Foreign: Giornale de Medicina Militare, L'Ospedale Maggiore, United States Public Health Service, Le Caducée, Bulletin de l'Institut Pasteur, Extrait des Annales de l'Institut Pasteur, Annual Reports of the United States Public Health Service, 1916, *Office International d'Hygiène publique, Bulletin of the Johns Hopkins Hospital, The Military Surgeon, Archives de Médecine et Pharmacie Navales, Archives de Médecine et de Pharmacie Militaires, The Journal of Infectious Diseases, Proceedings of the Medical Association of the Isthmian Canal Zone, Archives Médicales Belges, Norsk Tidsskrift for Militaermedicin.*

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
WAR OFFICE, WHITEHALL, S.W.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

AUGUST, 1917.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
July 9, 1917.

With reference to the list of awards of the Distinguished Conduct Medal announced in the *London Gazette* of 4th ult., the services for which these decorations were granted are specified below :—

No. 18830 Serjt. F. Bell, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He displayed the greatest gallantry and coolness in attending wounded under heavy fire, and has set a fine example to all.

No. 49644 Cpl. (Acting Serjt.) J. Rigby, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He has consistently displayed gallantry in collecting wounded under fire. He has set a fine example during a lengthy period.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officers and Man :—

No. 1121 Cpl. T. Trainor, Royal Army Medical Corps. (M.M. gazetted August 10, 1916.)

No. 386013 Serjt. W. W. Cowans, Royal Army Medical Corps. (M.M. gazetted October 27, 1916.)

No. 40222 Serjt. D. Semple, Royal Army Medical Corps. (M.M. gazetted December 21, 1916.)

No. 37128 Pte. (Acting Serjt.) A. C. Cardy, Royal Army Medical Corps. (M.M. gazetted February 19, 1917.)

His Majesty the King has been graciously pleased to award the Military Medal for bravery in the Field to the undermentioned Non-commissioned Officers and Men :—

No. 33498 Pte. T. Atkinson, Royal Army Medical Corps.
No. 421218 Pte. C. H. Barlow, Royal Army Medical Corps.
No. 10179 Pte. P. Batchelor, Royal Army Medical Corps.
No. 61464 Cpl. C. Bateson, Royal Army Medical Corps.
No. 34921 Pte. A. W. Beadnell, Royal Army Medical Corps.
No. 35106 Pte. F. H. Bell, Royal Army Medical Corps.
No. 11608 Pte. F. Bethle, Royal Army Medical Corps.
No. 417374 Pte. S. J. Brown, Royal Army Medical Corps.
No. 439013 Serjt. E. V. Cann, Royal Army Medical Corps.
No. 34202 Pte. (Acting Serjt.) J. Chisholm, Royal Army Medical Corps.
No. 64729 Pte. E. Clark, Royal Army Medical Corps.
No. 10544 Pte. W. Clough, Royal Army Medical Corps.
No. 421061 Serjt. T. E. Collins, Royal Army Medical Corps.

No. 3697 Pte. M. Connelly, Royal Army Medical Corps.
No. 5841 Cpl. (Acting Serjt.) W. E. Conway, Royal Army Medical Corps.
No. 584200 Pte. W. Cox, Royal Army Medical Corps.
No. 386199 Pte. T. Devine, Royal Army Medical Corps.
No. 473010 Serjt. C. Douse, Royal Army Medical Corps.
No. 8944 Pte. A. F. Drinkwater, Royal Army Medical Corps.
No. 36499 Serjt. R. Dyson, Royal Army Medical Corps.
No. 30729 Pte. W. Dyson, Royal Army Medical Corps.
No. 9755 Pte. S. East, Royal Army Medical Corps.
No. 41642 Pte. G. Edwards, Royal Army Medical Corps.
No. 35881 Cpl. (Lance-Serjt.) F. Fisk, Royal Army Medical Corps.
No. 62011 Pte. J. Foley, Royal Army Medical Corps.
No. 34625 Cpl. T. Foreman, Royal Army Medical Corps.
No. 337107 Pte. F. Foss, Royal Army Medical Corps.
No. 60559 Pte. A. Francis, Royal Army Medical Corps.
No. 51541 Pte. (Acting Lance-Cpl.) W. A. Fry, Royal Army Medical Corps.
No. 1635 Lance-Cpl. W. P. Grieve, Royal Army Medical Corps.
No. 9428 Pte. M. Harbottle, Royal Army Medical Corps.
No. 53912 Pte. J. Haugh, Royal Army Medical Corps.
No. 36118 Pte. A. Holdridge, Royal Army Medical Corps.
No. 60832 Pte. H. Hope, Royal Army Medical Corps.
No. 30904 Pte. J. A. Hubling, Royal Army Medical Corps.
No. 7915 Pte. J. Hughes, Royal Army Medical Corps.
No. 60493 Pte. E. Humphreys, Royal Army Medical Corps.
No. 6229 Pte. J. Hunt, Royal Army Medical Corps.
No. 41670 Pte. (Acting Serjt.) T. A. Johnson, Royal Army Medical Corps.
No. 341509 Serjt. B. Jones, Royal Army Medical Corps.
No. 50215 Pte. J. Keaty, Royal Army Medical Corps.
No. 303039 Cpl. G. M. Lawson, Royal Army Medical Corps (formerly No. 1354).
No. 6314 Cpl. (Acting Serjt.) J. Liddle, Royal Army Medical Corps.
No. 34167 Pte. (Acting Lance-Cpl.) W. J. Lintott, Royal Army Medical Corps.
No. 305141 Pte. D. C. Lowe, Royal Army Medical Corps (formerly 1518).
No. 390111 Lance-Cpl. J. H. Maack, Royal Army Medical Corps.
No. 83187 Pte. D. MacLennan, Royal Army Medical Corps.
No. 341448 Pte. J. Maguire, Royal Army Medical Corps.
No. 100187 Pte. A. Manssuer, Royal Army Medical Corps.
No. 53722 Pte. G. L. McAusland, Royal Army Medical Corps.
No. 32354 Acting Lance-Cpl. P. C. McFarlane, Royal Army Medical Corps.
No. 4649 Pte. H. McRoberts, Royal Army Medical Corps.
No. 69891 Pte. E. Midgley, Royal Army Medical Corps.
No. 53419 Pte. (Acting Lance-Cpl.) J. Millar, Royal Army Medical Corps.
No. 73621 Pte. T. Morris, Royal Army Medical Corps.
No. 50597 Pte. W. J. Morton, Royal Army Medical Corps.
No. 102643 Pte. A. Noble, Royal Army Medical Corps.
No. 305011 Serjt. R. Norris, Royal Army Medical Corps (formerly 867).
No. 31285 Pte. (Lance-Cpl.) V. H. Pace, Royal Army Medical Corps.
No. 8404 Pte. I. N. Parkinson, Royal Army Medical Corps.
No. 9092 Pte. P. Postlethwaite, Royal Army Medical Corps.
No. 41869 Serjt. B. E. Radford, Royal Army Medical Corps.
No. 67326 Serjt. E. J. Read, Royal Army Medical Corps.
No. 27796 Pte. A. Redden, Royal Army Medical Corps.
No. 31290 Cpl. A. S. O. Robinson, Royal Army Medical Corps.
No. 33335 Pte. R. Restron, Royal Army Medical Corps.
No. 46951 Cpl. H. Scandrett, Royal Army Medical Corps.
No. 1407 Cpl. (Acting Serjt.) G. Staples, Royal Army Medical Corps.
No. 77067 Pte. T. W. Stephenson, Royal Army Medical Corps.
No. 8659 Pte. H. J. Sturges, Royal Army Medical Corps.
No. 339209 Pte. W. Swithinbank, Royal Army Medical Corps.
No. 45195 Pte. D. Thompson, Royal Army Medical Corps.
No. 55847 Pte. G. F. Turner, Royal Army Medical Corps.
No. 403528 Pte. (Acting Lance-Cpl.) F. Watkinson, Royal Army Medical Corps.
No. 473141 Pte. C. J. Welham, Royal Army Medical Corps.
No. 388455 Lance-Cpl. J. G. Wells, Royal Army Medical Corps.

No. 38275 Pte. E. Williams, Royal Army Medical Corps.
No. 33000 Pte. C. Wood, Royal Army Medical Corps.

War Office,
July 14, 1917.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign:—

His Majesty the King has given unrestricted permission in all cases to wear the Decoration and Medals in question.

DECORATIONS AND MEDALS PRESENTED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

LEGION D'HONNEUR.

Croix de Chevalier.

Capt. (Acting Lieut.-Col.) Robert Magill, M.B., Royal Army Medical Corps, Special Reserve.
Major Edmund Thurlow Potts, D.S.O., M.D., Royal Army Medical Corps.
Temp. Capt. George Rankine, M.C., Royal Army Medical Corps.

Croix de Guerre.

No. 41290 Serjt.-Major Brice Wightman, Royal Army Medical Corps.

Medaille Militaire.

No. 47037 Serjt.-Major Henry Cooke Bell, Royal Army Medical Corps.

Croix d'Officier.

Lieut.-Col. William Richard Blackwell, Royal Army Medical Corps.

Croix de Chevalier.

Capt. Wilson Harold Percy Hey, M.B., F.R.C.S., Royal Army Medical Corps.
Capt. Frank Mainwaring Hughes, Royal Army Medical Corps.

Croix de Guerre.

Temp. Capt. Timothy Meagher, M.C., M.B., Royal Army Medical Corps.
Capt. James Alwin Colville Scott, M.C., M.B., Royal Army Medical Corps.
Temp. Capt. Charles Samuel Eric Wright, Royal Army Medical Corps.
Major William Harold Kerr Anderson, Canadian Army Medical Corps.
No. 4109 Pte. Peter Connors, Royal Army Medical Corps.
No. 3998 Pte. Timothy King, Royal Army Medical Corps.
No. 7326 Pte. (Acting Cpl.) Alfred James Mercer, Royal Army Medical Corps.
No. 43296 Pte. William Tomalin, Royal Army Medical Corps.
No. 534304 Serjt. John William Woods, Royal Army Medical Corps.

Medaille Militaire.

No. 62763 Pte. Sam Bates, Royal Army Medical Corps.
No. 66882 Serjt. Walter Frederick Brown, Royal Army Medical Corps.
No. 34207 Pte. James Charnley, Royal Army Medical Corps.
No. 1926 Cpl. Henry Clements, Royal Army Medical Corps.
No. 47495 Pte. Samuel Gwynne, Royal Army Medical Corps.

War Office,
July 18, 1917.

His Majesty the King has been graciously pleased to approve of the appointments of the undermentioned officers to be Companions of the Distinguished Service Order, in recognition of their gallantry and devotion to duty in the Field:—

Temp. Capt. James Harding Barry, M.C., Royal Army Medical Corps, attached London Regiment.

For conspicuous gallantry and devotion to duty in attending to the wounded under exceptionally trying conditions. Under very heavy shell fire he dug out five men who were buried and amputated two men's legs on the spot. He showed utter disregard of any personal risk, and his example was splendid.

Temp. Capt. James Henry Fletcher, M.C., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He showed the utmost bravery and coolness when commanding the bearers. He worked continuously under artillery and machine-gun fire. It was largely due to his gallant conduct that so many wounded were safely evacuated.

Australian Imperial Force.

Major Lionel Wilfred Bond, Australian Army Medical Corps.
For conspicuous bravery and devotion to duty. When in charge of advanced collecting and forwarding posts, his total disregard of danger under a terrific hail of gas shells, H.E. and shrapnel fire, gained him the confidence of all ranks, and greatly assisted the evacuation of the wounded. Later, although wounded and partly gassed, he refused to leave his post, and his bravery and devotion saved a very critical situation.

Major Herbert Percival Brownell, Australian Army Medical Corps.
For conspicuous gallantry and devotion to duty whilst attending to the wounded under heavy fire. His coolness in organizing matters amidst the greatest confusion enabled the wounded to be expeditiously treated, and he personally treated some hundreds of cases under heavy shell fire.

Major Horatio Victor Patrick Conrick, Australian Army Medical Corps.
For conspicuous gallantry and devotion to duty in attending to the wounded. He proceeded to the scene of an explosion under very heavy shell fire, and personally directed the removal of the wounded. His fearlessness and disregard for his personal safety has been marked on all occasions.

His Majesty the King has been graciously pleased to award a Bar to the Military Cross to the undermentioned Officers:—

Temp. Capt. Charles Bromley Davies, M.C., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He was in command of the bearer division when evacuation was most difficult. He showed great gallantry and resource in pushing forward under heavy fire and rescuing several wounded men. (M.C., gazetted August 25, 1916.)

Temp. Capt. James Churchill Dunn, M.C., M.D., Royal Army Medical Corps, attached Royal Welsh Fusiliers.
For conspicuous gallantry and devotion to duty in attending to the wounded. He crawled close up to the enemy's wire, accompanied by another officer, and brought in a wounded man on a waterproof sheet. (M.C., gazetted August 25, 1916.)

Temp. Capt. Harold Garnett Janion, M.C., Royal Army Medical Corps, attached Royal Horse Artillery.
For conspicuous gallantry and devotion to duty. He was assisting to remove the pilot from a wrecked aeroplane when the spot came under heavy fire from a hostile battery. Several of the bearers were wounded; but by his courage and example this officer collected fresh bearers and conveyed the wounded men to safety. This task was carried out under continuous shell fire. (M.C., gazetted June 23, 1915.)

Capt. Maurice Baylis King, M.C., M.B., Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty in rescuing wounded under very heavy shell fire. His fearlessness set a splendid example to the stretcher-bearers, who were then much shaken by the heavy shelling. (M.C., gazetted January 1, 1917.)

Temp. Capt. James Lennox Stewart, M.C., M.B., Royal Army Medical Corps, attached Gordon Highlanders.
For conspicuous gallantry and devotion to duty. He behaved with the utmost gallantry in removing the wounded under shell fire. He continued to work in the open exposed to severe shell and machine-gun fire until every wounded man had been brought in. (M.C., gazetted May 16, 1916.)

Australian Imperial Force.

Capt. George Seabourne Robinson, M.C., Australian Army Medical Corps.
For conspicuous gallantry and devotion to duty. He displayed great courage and determination in attending wounded under heavy fire. On one occasion he personally led a party out in front of our line for the purpose of searching and attending the wounded not yet collected. (M.C., gazetted June 4, 1917.)

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers and Warrant Officers in recognition of their gallantry and devotion to duty in the Field:—

Temp. Capt. Frederick Carson, M.B., Royal Army Medical Corps, Royal West Kent Regiment.

For conspicuous gallantry and devotion to duty. He behaved with the greatest gallantry in attending wounded under continuous heavy shelling. His total disregard for personal safety set a fine example to those around him.

Temp. Capt. Henry Joseph Cotter, Royal Army Medical Corps, attached Lincolnshire Regiment.

For conspicuous gallantry and devotion to duty. Although wounded on the previous day, he declined to be relieved, and continued to dress wounded in the open under heavy fire, going through heavy barrage to reach some men lying out in an exposed position.

Temp. Capt. Albert Victor Craig, M.B., Royal Army Medical Corps, attached Royal Field Artillery.

For conspicuous gallantry and devotion to duty. Though suffering himself from the effect of gas shells, he displayed the greatest bravery and the most untiring energy in attending to the wounded under fire of heavy guns and gas shells. He risked his life day and night without the slightest hesitation.

Temp. Capt. John Nissen Deacon, M.B., Royal Army Medical Corps, attached E. Yorks Regiment.

For conspicuous gallantry and devotion to duty. He showed exceptional bravery and resource on several occasions in attending to the wounded under very heavy shell fire, with complete disregard of his own personal safety.

Temp. Lieut. Cyril Duncan, M.B., Royal Army Medical Corps.

For conspicuous bravery and devotion in attending wounded close to a large ammunition dump which was on fire, with splinters and shrapnel shells flying about, and later, although partially gassed, attending wounded under heavy gas shell fire.

Temp. Capt. James Duncan Hart, M.B., Royal Army Medical Corps, attached London Regiment.

For conspicuous gallantry and devotion to duty. He commanded an aid post close to a piece of heavily-shelled roadway. He continually went out into the open road and attended wounded men under heavy fire, with a total disregard for his own personal safety.

Temp. Capt. Charles Reginald Ralston Huxtable, M.B., Royal Army Medical Corps, attached Lancashire Fusiliers.

For conspicuous gallantry and devotion to duty. He showed the utmost skill and bravery in attending to and evacuating wounded. When seven of his bearers were buried by a shell he at once, despite the intense hostile bombardment, organized a party and dug them out.

Temp. Capt. Charles Clouston Irvine, Royal Army Medical Corps, attached E. Yorks Regiment.

For conspicuous gallantry and devotion to duty. He took his stretcher-bearers out under heavy barrage fire and brought the wounded back safely, carrying one man back on his shoulders. His complete disregard for his own personal safety was most marked.

Capt. Cyril Jacobs, M.B., Royal Army Medical Corps, Special Reserve, attached Lincolnshire Regiment.

For conspicuous gallantry and devotion to duty. After an assault he went out over the whole ground in daylight, cleared as many of the wounded as possible, and having located the wounded who were in the enemy wire and close to it, completed his task by nightfall. He succeeded in evacuating all wounded men.

Temp. Capt. Richard Orthin Hilton Jones, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. For many hours he had to occupy a most exposed position under heavy fire, where he dressed and attended wounded at great personal risk.

Temp. Capt. Francis Kenneth Kerr, M.B., Royal Army Medical Corps, attached Royal Scottish Fusiliers.

For conspicuous gallantry and devotion to duty. During heavy and accurate hostile fire he continued to dress wounded, although the building was hit several times. His fine example was of the utmost value to those around him.

Temp. Lieut. Joseph Randolph Morell Mackenzie, M.B., Royal Army Medical Corps, attached S. Staffordshire Regiment.

For conspicuous bravery and devotion on numerous occasions when attending

wounded and leading stretcher-bearer parties under every kind of heavy and continuous fire, and invariably exhibiting great skill, coolness and contempt of danger.

Temp. Capt. Randal Vivian McDonnell, Royal Army Medical Corps, attached Bedfordshire Regiment.

For conspicuous bravery and devotion. For over forty-eight hours he attended more than 200 wounded, many having to be dressed in the open under heavy fire. His total disregard of personal danger was beyond praise.

Capt. Malcolm McGillivray, M.B., Royal Army Medical Corps, Special Reserve, attached S. Wales Borderers.

For conspicuous gallantry and devotion to duty. Although his dressing station was twice blown in, and himself extricated with great difficulty, he continued to attend wounded under heavy shell fire.

Temp. Capt. Daniel McKelvey, M.B., Royal Army Medical Corps, attached Gordon Highlanders.

For conspicuous gallantry and devotion to duty. During an attack by his battalion he followed them closely and attended to the wounded in the open under very heavy fire. His fearlessness and gallant conduct throughout the operations was most marked.

Temp. Capt. Murdo McKenzie McRae, M.B., Royal Army Medical Corps, attached Northumberland Fusiliers.

For conspicuous gallantry and devotion to duty. Owing to the shortage of bearers this officer carried in during the night seven or eight wounded men who otherwise would have died in the snow. He has performed consistent good work throughout.

Temp. Capt. Arthur Gilbert Michelsen Middleton, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He showed great gallantry and bravery in carrying in two wounded men under heavy hostile shelling. He displayed the utmost disregard for danger throughout in carrying out his duties.

Temp. Capt. George Lynn Pillans, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He showed great determination and courage in leading bearer squads through heavy barrage. This he did several times, and throughout superintended the evacuation under heavy shell fire.

Temp. Lieut. Joseph Rickards, M.B., Royal Army Medical Corps, attached Royal Scots.

For conspicuous gallantry and devotion to duty. He attended a large number of wounded in a barn which was under heavy shell fire. During the night he organized a party which brought in many wounded from an exposed position on the battlefield.

Temp. Capt. John Finlayson McGill Sloan, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. His dressing station being blown in on the top, he dressed over 200 cases under very difficult conditions. He had to twice change his dressing station.

Temp. Lieut. (Temp. Capt.) Harry Neville Stafford, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Having received a message that many wounded were on heavily-shelled ground, he organized rescue parties, and brought them all in, although he was severely wounded in this gallant work.

Temp. Capt. Charles Gordon Timms, Royal Army Medical Corps, attached Royal Fusiliers.

For conspicuous gallantry and devotion to duty. For two days he attended the wounded in the open under heavy and incessant shell fire, quite regardless of personal danger, and his coolness and energy alleviated much suffering.

Temp. Capt. William Annandale Troup, M.B., Royal Army Medical Corps, attached Wiltshire Regiment.

For conspicuous gallantry and devotion to duty. He displayed the utmost skill and endurance in clearing the wounded between the lines after the attack. Through the day he carried out his task under continuous shell fire, and was thus instrumental in saving many lives.

Capt. Alexander Guthrie Semple Wallace, M.B., Royal Army Medical Corps, Special Reserve, attached Royal Lancashire Regiment.

For conspicuous gallantry and devotion to duty. He continued to attend wounded men in the front line trench despite hostile bombardment. His total disregard for personal danger set a fine example to those around him.

Temp. Capt. Robert Bruce Wallace, M.B., Royal Army Medical Corps, attached Leicester Regiment.

For conspicuous bravery and devotion on many occasions, and notably when suffering from a painful wound he not only continued to dress wounded but went out with stretcher-bearers under heavy fire and dressed and brought in men unable to move.

Temp. Capt. Donald Alexander Warren, Royal Army Medical Corps, attached Royal Warwickshire Regiment (Lieut. C.A.M.C.).

For conspicuous gallantry and devotion to duty. He continued to attend wounded for over an hour under heavy artillery and machine-gun fire and in full view of the enemy. Later, he established an aid post and carried on for forty-eight hours without rest under continuous fire.

Temp. Capt. Philip James Watkin, Royal Army Medical Corps, attached Bedfordshire Regiment.

For conspicuous bravery and devotion. For two days he dressed wounded under heavy shell fire, and, when the captured trenches had been cleared, he commenced to search the shell holes in "No Man's Land" in spite of heavy sniping fire until ordered to desist.

Australian Imperial Force.

Capt. Charles Herbert Leedman, Australian Army Medical Corps.

For conspicuous gallantry and devotion. Although he and several of his staff were wounded by the heavy shelling of his post by the enemy, he continued, with the greatest gallantry, to attend the wounded, remaining at his post until it became untenable.

Capt. Cyril Charles Minty, Australian Army Medical Corps.

For conspicuous gallantry and devotion to duty. He showed the greatest courage and fearlessness in attending wounded whilst exposed to heavy shell fire and gas fumes, and assisting to carry them to the collecting post. The stretcher-bearers had suffered severe casualties, and it was owing to his magnificent example that they maintained their courage and endurance.

Canadian Force.

Capt. Hugh Hart, Canadian Army Medical Corps.

For conspicuous gallantry and devotion to duty. He displayed the utmost gallantry and courage in attending wounded continuously under heavy shell fire.

Capt. Douglas Ballantyne Kennedy, Canadian Army Medical Corps.

For conspicuous gallantry and devotion to duty. He directed the work of the stretcher-bearers for forty-eight hours without rest, and repeatedly aided the wounded under very heavy shell fire.

Capt. (now Temp. Major) Ronald Hugh Macdonald, Canadian Army Medical Corps.

For conspicuous gallantry and devotion to duty. One of our aeroplanes was shot down, the observer was wounded and pinned beneath the wreck. This officer and a bearer went out in full view of the enemy, who were shelling the machine, and extricated the wounded man and removed him to safety. He himself was severely wounded while doing so.

Capt. Robert James Manion, Canadian Army Medical Corps.

For conspicuous gallantry and devotion to duty. While going forward through a heavy hostile barrage to establish an aid post, he at great personal risk stopped and dressed alone nine wounded men.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Men, for acts of gallantry and devotion to duty in the Field:—

No. 1906 Cpl. (Acting Serjt.) A. T. Eames, Royal Army Medical Corps, attached Royal Scots.

For conspicuous gallantry and devotion to duty. He has shown consistent gallantry in attending wounded men under heavy fire. He has continually exposed himself in the open, and throughout has set a splendid example to all.

41640 Pte. R. Edwards, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He led a bearer party out between the lines in daylight under direct fire, and succeeded in bringing in a wounded man. One of the bearers was hit on the return journey, and Pte. Edwards then went back but found the bearer was dead.

388021 Serjt. J. H. Greenland, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked incessantly with relays of stretcher-bearers, assisting in the carrying himself. His coolness and endurance under heavy fire were most marked.

The following is the correct description of officer upon whom reward was conferred in the *London Gazette*, dated June 4, 1917:—

Lieut. (Temp. Capt.) Charles Coldie Sutherland, M.C., Royal Army Medical Corps (formerly Canadian Army Medical Corps).

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officer:—

No. 909 Serjt. J. H. Greenland, Royal Army Medical Corps (M.M., gazetted October 27, 1916).

His Majesty the King has been graciously pleased to award the Military Medal for bravery in the Field to the undermentioned Non-commissioned Officers and Men:—

No. 101396 Pte. R. Ashworth, Royal Army Medical Corps.
No. 80513 Pte. J. Baker, Royal Army Medical Corps.
No. 40445 Pte. (Acting Serjt.) H. H. Ball, Royal Army Medical Corps.
No. 510338 Pte. A. J. Bates, Royal Army Medical Corps.
No. 35612 Pte. J. Bays, Royal Army Medical Corps.
No. 18830 Serjt. F. Bell, Royal Army Medical Corps.
No. 424116 Pte. F. Bellamy, Royal Army Medical Corps (formerly 149).
No. 508300 Staff-Serjt. J. W. A. Billam, Royal Army Medical Corps.
No. 51301 Pte. A. Bishop, Royal Army Medical Corps.
No. 36780 Pte. R. H. Bond, Royal Army Medical Corps.
No. 50429 Pte. J. Bridson, Royal Army Medical Corps, attached Royal Field Artillery.
No. 38024 Cpl. C. E. Brooker, Royal Army Medical Corps.
No. 7030 Pte. J. A. Brooker, Royal Army Medical Corps.
No. 3224 Pte. J. Burke, Royal Army Medical Corps.
No. 512562 Cpl. H. M. Calcutt, Royal Army Medical Corps (formerly 839).
No. 22446 Pte. R. Carter, Royal Army Medical Corps.
No. 10158 Pte. W. H. Cattermole, Royal Army Medical Corps.
No. 34207 Pte. J. Charnley, Royal Army Medical Corps.
No. 508479 Pte. H. L. Chase, Royal Army Medical Corps.
No. 1595 Pte. J. Cleaver, Royal Army Medical Corps.
No. 38102 Pte. F. Clough, Royal Army Medical Corps.
No. 689 Pte. P. F. Coffey, Royal Army Medical Corps.
No. 33757 Serjt. J. Craig, Royal Army Medical Corps.
No. 495422 Lance-Cpl. L. G. Croft, Royal Army Medical Corps.
No. 38553 Pte. G. W. Crossley, Royal Army Medical Corps.
No. 301239 Pte. G. Cruikshank, Royal Army Medical Corps.
No. 3695 Pte. A. M. Dale, Royal Army Medical Corps.
No. 38225 Pte. (Acting Cpl.) G. Dent, Royal Army Medical Corps.
No. 1748 Pte. M. Doyle, Royal Army Medical Corps.
No. 7804 Pte. G. Edmonds. Royal Army Medical Corps.
No. 20260 Pte. H. E. Ellis, Royal Army Medical Corps.
No. 34056 Pte. F. W. Elms, Royal Army Medical Corps.
No. 34604 Pte. H. G. H. Enock, Royal Army Medical Corps.
No. 10657 Pte. W. D. Flamank. Royal Army Medical Corps.
No. 7767 Pte. J. Forbes, Royal Army Medical Corps.
No. 66493 Pte. (Acting Lance-Cpl.) D. G. Fryer, Royal Army Medical Corps.
No. 33910 Cpl. F. J. Gale, Royal Army Medical Corps.
No. 415087 Lance-Cpl. H. Gannon, Royal Army Medical Corps (formerly 1958).
No. 88299 Pte. L. Gardner, Royal Army Medical Corps.
No. 557 Pte. W. Garrett, Royal Army Medical Corps.
No. 81630 Pte A. George, Royal Army Medical Corps.
No. 419149 Pte. L. Goode, Royal Army Medical Corps.
No. 45602 Pte. J. Hall, Royal Army Medical Corps.
No. 405309 Pte. G. B. Harris, Royal Army Medical Corps.
No. 47638 Cpl. E. R. Harrison, Royal Army Medical Corps.
No. 318096 Pte. J. Harvey, Royal Army Medical Corps (formerly 98).
No. 32220 Cpl. W. N. Haseldine, Royal Army Medical Corps.
No. 43931 Serjt. T. Hogarty, Royal Army Medical Corps.
No. 76834 Pte P. H. Hodges, Royal Army Medical Corps.
No. 446012 Serjt. E. Honey, Royal Army Medical Corps (formerly 19134).
No. 38154 Lance-Cpl. J. Huggett, Royal Army Medical Corps.
No. 47230 Pte. (Acting Lance-Cpl.) R. M. Jamieson, Royal Army Medical Corps.
No. 5281 Serjt. A. Jerred, Royal Army Medical Corps.
No. 62146 Pte. (Acting Serjt.) W. Jordan, Royal Army Medical Corps.
No. 339198 S. J. Kay, Royal Army Medical Corps.
No. 56674 Pte. J. Kiddy, Royal Army Medical Corps.
No. 401327 Serjt. H. Knaggs, Royal Army Medical Corps.

No. 301258 Pte. W. Masson, Royal Army Medical Corps.
No. 64707 Pte. M. L. Moore, Royal Army Medical Corps.
No. 1834 Pte. S. Morris, Royal Army Medical Corps.
No. 2919 Pte. N. Murray, Royal Army Medical Corps.
No. 37499 Pte. R. Ogden, Royal Army Medical Corps.
No. 475178 Cpl. L. H. Paget, Royal Army Medical Corps, attached Norfolk Regiment.
No. 45469 Pte. G. H. A. Partridge, Royal Army Medical Corps.
No. 8446 Pte. P. M. Patmore, Royal Army Medical Corps.
No. 435282 Cpl. A. H. Perry, Royal Army Medical Corps.
No. 534005 Serjt. (Acting Staff-Serjt.) W. C. Perryman, Royal Army Medical Corps.
No. 49150 Pte. F. D. Rhodes, Royal Army Medical Corps.
No. 32435 Pte. C. Richardson, Royal Army Medical Corps.
No. 54263 Pte. W. Richardson, Royal Army Medical Corps.
No. 457364 Pte. W. R. O. Sanders, Royal Army Medical Corps.
No. 512561 Pte. R. J. Shambrook, Royal Army Medical Corps (formerly 838).
No. 32982 Serjt. C. W. Smith, Royal Army Medical Corps.
No. 66177 Pte. J. Stickland, Royal Army Medical Corps.
No. 42871 Pte. J. F. Stone, Royal Army Medical Corps.
No. 32449 Pte. S. Storey, Royal Army Medical Corps.
No. 41453 Cpl. C. S. Stott, Royal Army Medical Corps, attached Royal Flying Corps.
No. 301337 Lance-Cpl. C. G. Swapp, Royal Army Medical Corps.
No. 435306 Pte. D. Tapper, Royal Army Medical Corps.
No. 66304 Pte. (Acting Cpl.) J. V. Thomas, Royal Army Medical Corps.
No. 40234 Pte. A. L. Thomson, Royal Army Medical Corps.
No. 405444 Pte. E. Thornton, Royal Army Medical Corps.
No. 508053 Pte. A. J. Tipper, Royal Army Medical Corps.
No. 78300 Pte. W. Todd, Royal Army Medical Corps.
No. 56267 Pte. G. C. Turner, Royal Army Medical Corps.
No. 341 Pte. W. Warden, Royal Army Medical Corps.
No. 4800 Pte. (Acting Lance-Cpl.) A. F. Washbourne, Royal Army Medical Corps.
No. 435391 Pte. J. R. Wiggins, Royal Army Medical Corps.
No. 366238 Pte. (Lance-Cpl.) R. J. Williams, Royal Army Medical Corps, attached Royal Welsh Fusiliers (formerly 2201).
No. 1330 Pte. J. Wilson, Royal Army Medical Corps.
No. 58308 Pte. H. Worswick, Royal Army Medical Corps.
No. 439074 Pte. W. J. Young, Royal Army Medical Corps (formerly 1852).

War Office,
July 21, 1917.

The Secretary of State for War has received the following dispatch from Lieut.-Gen. G. F. Milne, C.B., D.S.O., Commanding-in-Chief, British Salonika Force:—

General Headquarters,
Salonika,
March 29, 1917.

My Lord,—I have the honour herewith to submit a list of the names of the Officers, Warrant Officers, Non-commissioned Officers, Men, and Nursing Staff whose services I wish to bring to notice for distinguished service rendered during the past six months in this theatre of operations.

I have the honour to be, My Lord,
Your Lordship's most obedient Servant,
G. F. Milne,
Lieut.-Gen, Commanding-in-Chief,
British Salonika Force.

Army Medical Service.

Temp. Col. F. D. Bird, C.B.

Royal Army Medical Corps.

Lieut.-Col. (Temp. Col.) J. C. Connor.
Lieut.-Col. (Temp. Col.) G. T. K. Maurice, C.M.G.
Lieut.-Col. (Temp. Col.) P. MacKessack.
Major (Temp. Lieut.-Col.) J. Matthews.
Capt. (Acting Lieut.-Col.) P. G. M. Elvery, M.C.
Capt. (Acting Lieut.-Col.) A. D. O'Carroll.
Capt. (Acting Lieut.-Col.) G. H. Stevenson.
Capt. (Acting Lieut.-Col.) B. Johnson.
Major W. J. Weston.

Major R. K. White.
Major F. J. Garland.
Major P. H. Henderson, D.S.O.
Temp. Major H. Wiltshire.
Capt. (Temp. Major) C. M. Fegen.
Capt. J. H. Beverland.
Capt. R. G. Shaw.
Capt. D. V. M. Adams, Reserve of Officers.
Capt. A. L. Urquhart.
Capt. J. P. Litt.
Capt. C. Clarke.
Capt. D. M. Corbett.
Capt. C. S. Staddon, Special Reserve.
Temp. Capt. D. Bird.
Temp. Capt. W. H. Fleetwood.
Temp. Capt. St. J. D. Buxton.
Temp. Capt. R. S. Dewar.
Temp. Capt. G. B. Holroyde,
Temp. Capt. W. A. L. H. Henderson.
Temp. Capt. A. G. Howson.
Temp. Capt. J. H. Box.
Temp. Capt. J. H. Cuthbert.
Temp. Capt. J. F. W. Leech.
Temp. Capt. J. M. Macfie.
Temp. Capt. C. A. Boyd.
Temp. Capt. F. Paine.
Temp. Capt. S. H. Hay.
Temp. Capt. T. E. Parker.
Temp. Lieut. J. M. Hammond, D.S.O., M.B. (died of wounds).
Temp. Hon. Lieut. and Qmr. A. J. Wiseman.
Hon. Lieut. and Qmr. T. E. Coggon, M.C.
Hon. Lieut. and Qmr. A. T. Hasler, M.C.
Capt. T. Carnwarth.
No. 32011 Serjt.-Major W. Adkins.
No. 82251 Serjt.-Major G. F. Lyon.
No. 30179 Serjt.-Major L. Hayes.
No. 754 Serjt. (Acting Serjt.-Major) H. Russell.
No. 57687 Pte. (Acting Qmr.-Serjt.) N. Brown.
No. 52897 Serjt. J. H. Scott.
No. 40210 Cpl. (Acting Serjt.) W. H. Selley.
No. 39203 Pte. (Acting Serjt.) P. Broderick.
No. 79594 Pte. (Acting Serjt.) W. J. Read.
No. 79335 Pte. (Acting Serjt.) W. Kampff.
No. 44049 Cpl. B. S. Lord.
No. 5677 Pte. (Acting Cpl.) E. J. Smale.
No. 46414 Pte. (Acting Cpl.) W. Baird.
No. 47807 Pte. D. C. Rees.
No. 10854 Pte. C. E. Ketteringham.
No. 57440 Pte. P. C. Allen.
No. 9879 Pte. L. H. Sloggett.
No. 25974 Pte. G. Lane.
Capt. R. O. Eades.
Qmr. and Hon. Lieut. P. A. Baynes.
Major (Temp. Lieut.-Col.) D. L. Fisher.
Capt. E. G. Gauntlett.
Major (Temp. Lieut.-Col.) A. E. Kidd.
Capt. J. Mair.
Capt. G. P. Mills, M.B.
Temp. Major K. W. Montsarratt.
Capt. W. L. Murphy.
Capt. L. G. Parsons.
Capt. F. H. Robbins.
Capt. F. Scroggie.
Capt. (Temp. Major) W. D. Sturrock.

Major E. B. Waggett.
Capt. V. H. Wardle.
Lieut.-Col. J. R. Whait, M.B.
No. 533032 Corpl. R. C. Brischlayer.
No. 527611 Corpl. (Acting-Serjt.) C. Brown.
No. 510059 Serjt. C. W. Collishaw.
No. 512002 Qmr.-Serjt. (Acting Serjt.-Major) H. W. H. Canham.
No. 527553 Staff-Serjt. T. P. Dixon.
No. 497620 Pte. W. H. Fenner.
No. 493025 Pte. T. Harris.
No. T/257056 Serjt. J. Hartley.
No. 323007 Cpl. (Acting Serjt.) W. McKim.
No. 497004 Qmr.-Serjt. W. G. Mildenhall.
No. 495053 Pte. A. J. Shorter.
No. 1532 Pte. A. Snowball.
No. 527282 Cpl. (Acting Qmr.-Serjt.) A. H. Stewart.
No. 527163 Pte. H. J. Tickner.
No. 536003 Qmr.-Serjt. A. Vile.

War Office,
July 23, 1917.

ADDITIONAL MENTIONS IN DISPATCHES.

The following names are added to the list of officers, ladies, non-commissioned officers and men recommended for distinguished and gallant services and devotion to duty in the dispatch from the Field-Marshal Commanding-in-Chief, the British Armies in France, dated April 9, 1917, which was published in the *London Gazette* dated May 15, 18, 22, 25, and 29, and June 1, 1917:—

Lieut.-Col. G. H. Goddard, Royal Army Medical Corps.
Temp. Capt. (Acting Lieut.-Col.) L. D. Shaw, M.B., Royal Army Medical Corps.

SUPPLEMENT TO THE *London Gazette*, DATED MAY 29, 1917 (No. 30101).

Under Army Medical Service (p. 5320), for Col. C. H. Burtcheal, C.M.G., M.B., read Col. C. H. Burtchaell, C.M.G., M.B.

Under Royal Army Medical Corps, for Temp. Capt. J. Davidson, M.B., read Capt. J. Davidson, M.B., Special Reserve.

For Capt. G. T. Van Der Vyver, M.B., Special Reserve, read Capt. G. T. Van Der Wyver, M.B., Special Reserve.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

SUMMARY OF THE PROCEEDINGS OF A QUARTERLY MEETING OF THE COMMITTEE HELD AT THE ROYAL ARMY MEDICAL COLLEGE ON JULY 26, 1917.

Present:

Dep. Surg.-Gen. W. G. Don, Vice-President, in the Chair.
Lieut.-Col. J. More Reid.
Lieut.-Col. G. S. Mansfield.
Capt. W. F. M. Loughnan, M.C.
The Secretary.

---

(1) The Minutes of the previous meeting were read and confirmed.

(2) The death was reported of Lieut.-Col. Augustus Frederick Elliot, aged 83, and his widow was placed on the list of annuitants. (She is the first annuitant who receives a grant of £200, from distribution of surplus, under Rule X.)

(3) The deaths were reported of two annuitants—Mrs. Dorothy Laidlaw Munro and Mrs. Joanne Josephine Gaffney.

(4) The Secretary reported that he had received a gift of Rs. 250 from the Royal Army Medical Corps Mess, Rawal Pindi. It seemed probable that this may have been intended for the Royal Army Medical Corps Officers' Benevolent Fund, and in thanking the donors for their liberal gift he had made inquiry on this point before presenting the draft. The Committee approved this action.

(5) The Secretary reported that £996 2s. 6d. five per cent War Stock, 1929/47 had been purchased out of surplus cash balance at a cost of £941 1s. 1d. This addition brings the total holding in this stock up to £124,000.

(6) A Trustee's receipt for payment by the Secretary of his guarantee premium was submitted.

(7) The Secretary reported that individual notices had been sent to all officers known to have been gazetted to permanent commissions in the Corps since the outbreak of War, explaining the benefits assured by the Society and the present terms of admission.

(8) Payment was sanctioned of the Secretary's salary and office allowance for the quarter ending June 30, and also of the printer's bill.

3, *Homefield Road,* J. T. Clapham, *Captain,*
Wimbledon, S. W. 19. *Secretary.*

This Fund provides annuities of £50 a year (together with any additional benefits which may be available from distribution of surplus), to the widows of subscribers and to their children under 21 years of age. The annual subscription varies according to the ages of husband and wife : e.g., in the case of a husband aged 30 and wife aged 25, it would amount to £14 18s. 6d. ; where husband and wife were both aged 28 it would be £12 19s. 11d. At the outbreak of war an additional war charge of 50 guineas per annum was made, and eligibility for membership was limited to officers on the strength of the Corps on that date.

The death-rate amongst officers of the Corps having been lower in the later stages of the war than was expected, the Committee have been able to reduce the extra war charge to one of 25 guineas per annum, in addition to the normal annual subscription according to scale. It has also been resolved that officers gazetted to permanent commissions in the Corps on January 1, 1917, and up to May 22, 1917, shall be eligible for membership on the above terms. The cases of those who may be gazetted later will be considered as they arise.

The Secretary will be glad to give any further information as to details.

J. T. Clapham,
Captain, Secretary.

3, *Homefield Road,*
Wimbledon, S. W. 19.

AUXILIARY ROYAL ARMY MEDICAL CORPS FUNDS.

Proceedings of a Special Committee Meeting held at 124, Victoria Street, on August 17, 1917, at 3 p.m.

Present :—

Major E. J. Maclean, Chairman.
Surg.-Gen. Sir W. Cheyne, Bt., C.B., R.N., one of the Trustees.
Col. Culver James.
Lieut.-Col. W. Collier.
Lieut.-Col. W. Hale White.
Lieut.-Col. Mansell-Moullin.

(1) A draft Resolution to carry into effect the separation of the accounts of the Benevolent and Relief Branches was considered and approved as follows :—

"With reference to paragraph 5 of the Proceedings of the Committee dated July 19, relative to the Resolution prepared by Messrs. Holt and Co., it was

"Resolved that, as it now appears that £7,100 War Loan Stock standing in the names of the Trustees belongs as to £3,500 to the Officers Benevolent Branch, and as to £3,600 to the Relief Branch, the Secretary should instruct the Bankers to take the necessary steps to have the former amount allocated to the 'A' account to be opened in the Bank of England Stock Books in the names of the Trustees, and £3,600 in the 'B' account, and not £3,550 to each account as directed in the Resolution passed on the 19th July last, the terms of which will in other respects hold good."

(2) The Secretary reported the separation of the accounts and opening of new ledgers in accordance with the Resolution referred to in paragraph 5 of the Proceedings of the Committee dated July 19. The following amounts were approved for investment in the New 5 per cent War Loan :—

Benevolent Branch	£300
Relief Branch	800

The Secretary was authorized to pay Messrs. Holt and Co. £2 2s. for clerical assistance rendered.

(3) A draft resolution was approved for submission to the next Committee meeting in accordance with paragraph 11 of the meeting of July 19 as follows :—

"Resolved in order that relief from the Benevolent Branch to orphans of officers may be granted in urgent cases more frequently than once a year at the Annual General Meeting that Rule 20 may be amended by the addition of the following words at the end of the Rule: 'or in special cases, by the Committee, provided that no grant for any one case shall exceed £20 before the next General Meeting of Subscribers (see Rule 5), the necessary alterations to be made in other Rules to admit of this being done.'"

(4) A preliminary draft for the Annual Report was considered, amended, and ordered to be laid before the next Committee Meeting.

(5) A letter was read from the Clerk of the London County Council relative to the appointment of a Treasurer, and it was proposed by the Chairman, and seconded by Colonel Culver James: "That Lieut.-Col. C. Mansell Moullin be appointed Treasurer subject to confirmation by the next Committee Meeting. Also that in future all cheques should be signed by the Treasurer and countersigned by the Secretary."—*Carried.*

The Secretary was directed to notify Messrs. Holt and Co. and the Clerk of the London County Council accordingly.

Notice is hereby given that the Annual General Meeting of the Auxiliary Royal Army Medical Corps Funds will be held at the Royal Army Medical College, Grosvenor Road, on Friday, October 26, 1917, at 3 o'clock.

The Director-General Army Medical Service has kindly consented to preside.

All subscribers to the funds are invited to be present.

OBITUARY.

THE LATE LIEUTENANT-COLONEL A. F. S. CLARKE, M.D., A.M.S., Retired.

Deputy Surg.-Gen. Don writes: The death, on the 11th inst., of Lieut.-Col. A. F. S. Clarke, aged 78, recalls to me a friendship between us of more than forty years, and a desire to pay a short tribute to his memory.

He was widely known to the service seniors and the contemporaries of his day, but to the great majority of medical officers now serving, can only be little else than a name. Yet he was an officer of mark in his time, as one always striving for the honour and reputation of his department and having a high sense of duty, and of careful skill in professional work.

To those who, like myself, had the privilege of his personal friendship, he was endeared, by engaging, cheery manners, patent sincerity and general amiability of character.

He entered the service in 1861, was appointed to the Black Watch but afterwards to the Royal Artillery, in which he served for years, and was for some time in charge of the famous Royal Horse "A" Battery, or the "Chestnut Troop."

The last five years of his full-pay service was in the "Sanitary" while I was in the "Medical" Branches, at Headquarters in the War Office, and there we were naturally much thrown together, both in social life and on duty.

In 1882 he accepted the retired list in order to take up the important medical charge of the Royal Military and Staff Colleges, a position which he occupied with conspicuous success for twenty-two years, until final retirement under the age limit of 65. He thus became known to thousands of officers and cadets passing through Sandhurst and Camberley, many of whom had good cause for gratitude towards his skill and attention during sickness; for it is stated as remarkable that in the many years of his charge no one lost his life from sickness! His sanitary training also enabled him to cope so successfully with an epidemic of diphtheria at Sandhurst as to elicit the thanks and praise of H.R.H. the Duke of Cambridge.

I may here record, what is now little known or half forgotten, that in 1881, while in the War Office, Clarke and I, with the full concurrence of the Director-General, Sir William Muir, together inaugurated the first "Annual Dinner" of the medical department. It was a venture towards unification. At first received with some coldness by old regimental medical officers, who had corps' dinners of their own; and with banter and ridicule from the then section of the military authorities, who affected to regard the "doctors" as a sort of "camp followers," unfitted for such collective effort. But the dinner was a success and took root, thenceforward to develop into the annual gathering of a consolidated Royal Army Medical Corps.

After final retirement, Col. Clarke took an active interest as a Trustee on the Committee of Management of the Army Medical Officers' Widows and Orphans Fund: a Friendly Society now over a century old, which has attained a very strong financial position, and offers to its (voluntary) members—at reasonable actuarial rates of subscription—substantial bonuses and annuities to their widows.

He was entirely laid aside from heart affection about a year ago, from which he finally succumbed. He leaves a widow and only son, Brig.-Gen. I. L. F. Clarke, East Yorkshire Regiment, who has done recent distinguished service at the Front in France.

BIRTH.

HARRISON.—On June 8, at 77, Prince of Wales Mansions, Battersea Park, S.W. the wife of Lieut.-Col. L. W. Harrison, R.A.M.C., of a daughter.

MARRIAGE.

MORGAN—WHAITE.—August 15, 1917, at St. Paul's, Rusthall, Tunbridge Wells, by the Rev. D. Musgrave, M.A., C.F., assisted by the Rev. G. B. Charles and the Rev. G. F. Relton, Captain F. E. Morgan, R.A., eldest son of F. Beverley Morgan, Esq., J.P., "Mascalls," Paddock Wood, Kent, to Marjorie Cecile, only child of Colonel T. du B. Whaite, C.M.G., A.M.S., and Mrs. Whaite, of Cullenswood Lodge, Sandford Road, Dublin.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

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	8	0 6 0	0 2 9	4 10	1 6	4 4	0 11
	16	0 10 6	0 5 0				
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	8	0 7 6	0 3 6	6 0	2 1	4 10	1 2
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1				
	8	0 10 0	0 4 10	7 10	3 11	6 7	2 5
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5				
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* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "Journal of the Royal Army Medical Corps," 324, Adastral House, Victoria Embankment, E.C. 4.

Communications have been received from Majors J. W. Hutchinson, L. J. Rhea, P. Turner, A. F. Hurst, F. B. Jefferies; Captains G. Richardson, R. L. Scott, E. E. Roberts, J. R. McCurdie, C. McDowall, K. Black, E. P. Reeve, J. H. Lloyd, G. H. Davy, A. B. Porteous, J. H. M. Frobisher, A. H. Coleman, H. C. Semon, H. W. Barber, J. A. Hartley, W. T. Tyndall; Quartermaster-Serjeant C. W. Newell; Corporal E. S. Radmore. Amara Clinical Society: Annual Report of the Central Laboratory, Amara.

The following publications have been received:—

British: Proceedings of the Royal Society of Medicine, The Journal of Tropical Medicine and Hygiene, The Hospital, Medical Press and Circular, The Medical Journal of Australia, St. Bartholomew's Hospital Journal, Guy's Hospital Gazette, The Indian Medical Gazette, The Medical Review, Bulletin of Entomological Research, Tropical Diseases Bulletin, The Medical Journal of South Africa, The Royal Engineers' Journal, Commonwealth of Australia Quarantine Service, The United Service Institute of India, Simla, Journal of the Royal Naval Medical Service, Transactions of the Society of Tropical Medicine and Hygiene, The Indian Journal of Medical Research, Journal of the Royal United Service Institution, The Journal of State Medicine.

Foreign: Giornale de Medicina Militare, L'Ospedale Maggiore, United States Public Health Service, Le Caducée, Bulletin de l'Institut Pasteur, Extrait des Annales de l'Institut Pasteur, Annual Reports of the United States Public Health Service, 1916, *Office International d'Hygiène publique, The Military Surgeon, Archives de Médecine et Pharmacie Navales, Archives de Médecine et de Pharmacie Militaires, The Journal of Infectious Diseases, Archives Médicales Belges, Norsk Tidsskrift for Militaermedicin, The American Journal o Syphilis, United States Naval Medical Bulletin.*

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
25, ADASTRAL HOUSE, VICTORIA EMBANKMENT, E.C. 4.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

SEPTEMBER, 1917.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
July 26, 1917.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign:—

His Majesty the King has given unrestricted permission in this case to wear the Decoration and Medal in question:—

DECORATION CONFERRED BY HIS MAJESTY THE KING OF THE BELGIANS.
Ordre de Léopold: Chevalier.

Temp. Capt. Myer Coplans, D.S.O., Royal Army Medical Corps.

War Office,
July 26, 1917.

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned Officer to be Companion of the Distinguished Service Order in recognition of his gallantry and devotion to duty in the Field:—

Temp. Capt. Harold Saunderson Sugars, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He showed magnificent disregard of personal safety in attending to the wounded under heavy fire for five days. On the fifth day his leg was broken, but this did not prevent him from going through heavy shell fire to save the life of a corporal whose main artery had been cut, and who required immediate attention. His fearlessness in crossing the open under continuous and heavy fire to save life or to alleviate suffering was most marked.

His Majesty the King has been graciously pleased to award a second Bar to the Military Cross to the undermentioned Officer:—

Temp. Capt. Allen Coulter Hancock, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He established his A.D.S. in the village, although it was under very heavy shell fire. He attended and evacuated a very large number of wounded, working all night, finally going out himself along the front to see if there were any left. M.C. gazetted December 11, 1916; first Bar, February 15, 1917.

His Majesty the King has been graciously pleased to award a Bar to the Military Cross to the undermentioned Officer:—

Temp. Capt. Clarence Randolph Young, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in attending to the wounded under heavy fire, with the utmost disregard for his own safety. The trench in which he had

established his forward dressing station was blown in, in many places by intense hostile barrage, which continued for an hour. His example had a powerful effect on all the stretcher bearers, and it was entirely due to his resource and coolness that all the wounded were safely evacuated. M.C. gazetted November 14, 1916.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers in recognition of their gallantry and devotion to duty in the Field :—

Lieut. Ivor Aubrey, Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty. He led a party of bearers through heavy shell fire, and collected and dressed wounded all night. This work he carried on in daylight under observation from the enemy and heavy fire, carrying back an officer on his back from the enemy wire.

Temp. Capt. John Dorrington Batt, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in digging out a number of men who had been buried by a shell. Whilst doing so another shell killed and wounded all who were there, and he was partially buried himself. He continued his work of rescuing other men and dressing their wounds regardless of all danger.

Capt. William Mervyn Biden, M.B., Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty. His organization for the evacuation of the wounded was admirable. With total disregard of danger he personally supervised the stretcher parties, who worked in daylight in full view of the enemy.

Temp. Capt. Maurice Smith Bryce, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. On three occasions he walked through the enemy barrage to the captured trenches, where he treated the wounded and took them back to the Field Ambulance. He set a splendid example by his fearlessness and devotion to duty.

Temp. Capt. Claude Norman Coad, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in proceeding alone, under intense enemy barrage, to the aid of a wounded officer, whom he brought safely back under circumstances of the greatest personal risk over ground swept by enemy fire. He spent the night in No Man's Land, displaying the highest courage and devotion to duty in evacuating the wounded under continual heavy fire.

Capt. Robert Scott Cumming, M.B., Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty. For thirty-six hours he worked continuously in evacuating and dressing wounded under heavy shell fire. Throughout he set a magnificent example to those under him.

Temp. Capt. Otto de Muth, M.D., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty whilst attending to the wounded under very heavy fire. His initiative and total disregard of danger enabled the evacuation of the wounded to be successfully carried out during a very trying period. No personal danger seemed too great for him to face in the performance of his duties.

Temp. Capt. Herman Gerald Dresing, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. After being shelled out of his dressing station, he took up another position, and continued throughout the day, and performed operations under heavy shell fire, which was causing continual casualties around him.

Temp. Capt. Alexander Galletly, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in taking bearer parties forward under heavy fire to collect wounded from a front line trench. His conduct throughout was admirable. He was continually on duty for forty-eight hours.

Temp. Capt. James Gaston, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He attended the wounded of five other units besides his own throughout the day. The next day he led a party out in front and recovered twelve more wounded who were lying out. Throughout he set a splendid example to all.

Temp. Capt. George Charles Gaynor, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when attending to the wounded. He showed magnificent disregard of danger in going constantly through heavy barrage to fulfil his medical duties, greatly assisting and encouraging all ranks by his example. He has on previous occasions performed similar gallant work.

Temp. Capt. Austin Charles Giles, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. Though suffering severely from gas poisoning, and unable to stand without assistance, he continued for many hours to attend to wounded and gassed men, refusing to rest himself till all had received attention.

Temp. Capt. Robert Hannah, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in attending to the wounded under very heavy shell fire. He also made four journeys into No Man's Land, under shell, rifle, and machine-gun fire, and brought in the wounded and attended to them. He set a magnificent example of fearlessness to the men.

Temp. Capt. Ronald Hodson, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When in charge of the bearers he ensured the rapid clearance of wounded by closely following the advance of shell fire. Throughout he set a fine example of coolness and courage.

Temp. Capt. William Leslie, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. For six days he was at the A.D.S., which was shelled almost continuously. His work had to be done out in the open, where there was very little cover owing to the accumulation of cases. His work throughout deserves the highest praise.

Temp. Capt. Joseph Paterson Lusk, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He attended the wounded where they fell by the enemy trench under very heavy fire. His disregard of self and consideration for the wounded set a splendid example to all.

Temp. Lieut. James Wallace Macfarlane, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He went through a heavy gas shell fire to dress a wounded man. Finding it impossible to perform this work with the gas mask on, he removed it at great risk and completed his task before putting it on again.

Temp. Capt. Robert John Bowman Madden, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked continually for thirty hours under heavy fire leading and organizing stretcher bearers. Throughout he set a splendid example.

Capt. Robert Paul Scott Mason, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty, in tending the wounded of several batteries. To do this he had to pass through very heavy shell fire, and on this, as on previous occasions, he showed absolute disregard of personal danger.

Capt. Samuel McCausland, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. Under very heavy and continuous shell fire he systematically searched from cellar to cellar of a village until he had successfully cleared his part of the village of all wounded. These included many who had been lying there for days, and who could not be moved owing to the intensity of the enemy barrage. He worked unceasingly amidst conditions of the greatest possible danger for thirty hours.

Temp. Capt. Archibald Gladstone Naismith, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When supervising the erection of an A.D.S. he was knocked down and stunned by a shell which wounded most of the party. On recovery he at once attended to the wounded, and remained until this was completed.

Temp. Capt. Kenneth Montague Nelson, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in attending to the wounded with the utmost fearlessness under heavy shell and machine-gun fire. He constantly went out to our most advanced positions in aid of the wounded, and his careful search of the battlefield resulted in most of the more serious cases being found and brought back to the dressing station. His unselfish devotion was directly the cause of many lives being saved.

Temp. Capt. William Bentley Purchase, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty, in attending to a wounded driver, with whom he remained under heavy shell fire until he died, having ordered two of his men to go to a place of safety. He had previously showed exceptional bravery and

promptness in responding to a call for medical help earlier in the day, when four officers had been killed by shell fire in the battery.

Temp. Capt. Arthur Carlie Sturdy, F.R.C.S., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He attended wounded for many hours under heavy fire. He showed a complete disregard for danger in organizing search parties, and recovered wounded who had been left for several days.

Capt. Joseph Stephen Wallace, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of bearing parties, in so organizing and handling his stretcher bearers amidst heavy shell and gas barrage that a very large number of our wounded were brought in to safety. His conduct was conspicuous throughout for coolness, good judgment, and total disregard of danger. He had been knocked out by gas the day before but insisted on remaining at his post.

Capt. John Roolo Noel Warburton, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He showed great courage and devotion in his treatment of wounded. The press of cases was very heavy, and he worked all night and the next day.

Temp. Capt. John Victor Williams, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He took a party of bearers up, and, crossing the open under very heavy shell fire, dressed all the wounded and returned with them, going out later and coming in with the lost squads. He worked for four nights and days.

CANADIAN FORCE.

Capt. Arthur Chester Armstrong, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty. He displayed great courage and determination in tending the wounded under very heavy fire. His devotion to duty saved many lives.

Capt. (Acting Major) Harold Buck, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty. He led his bearers with great gallantry and was responsible for the evacuation of a large number of wounded men. He set a fine example to all ranks.

Capt. Alva Burton Chapman, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty. One of our planes being shot down he went to the assistance. On his way he was wounded in the head. He continued on his way to the machine, which was being heavily shelled, attended to one of the occupants, and had him carried away.

Capt. Waring Gerald Cosbie, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty. He led his bearers into the open under heavy fire, and rescued many wounded man. He worked continuously for forty-eight hours under very heavy fire.

Capt. William Creighton, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of an advanced dressing station. He took command of a party and searched for wounded for six hours under heavy shell fire, bringing in all our wounded as well as those of the enemy. His gallantry was most inspiring to his men.

Capt. William Hale (Junior), Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty. He established a dressing station in a forward area, and worked untiringly for sixty hours under fire, dressing the wounded. He set a fine example of courage and determination.

Capt. Edward Shapter Jeffrey, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty. Under continuous shell fire he directed and steadied the stretcher parties. His fine example and courage enabled all wounded to be cleared before nightfall.

Capt. Richard Wellington Kenny, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty. He unceasingly attended wounded in his dressing station. He improvised an additional station in an adjacent trench and carried on his work under shell fire. He has done previous good work in the same capacity.

Capt. Charles Kerr, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty, when in charge of regimental aid posts. He continually exposed himself to heavy fire, with the result that every wounded man was cleared as soon as his wounds were dressed. He has on several occasions shown most unselfish devotion in the care of wounded.

Capt. Hugh Roy Mustard, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty in dressing the wounded of a battery in the open, exposed to heavy shell fire for two hours. He then continued at an exposed post for three days dressing wounded and he has on several occasions exhibited great courage and devotion of the same kind.

Capt. Donald George Kennedy Turnbull, Canadian Army Medical Corps.
For conspicuous gallantry and devotion to duty. He showed continual fearlessness and splendid devotion in making his way under the heaviest fire to the most advanced parts of the battlefield to establish dressing stations and attend to the wounded. No undertaking seemed too perilous for him; he constantly dressed wounded in the front line, and the example he set to his stretcher bearers and carrying parties was at all times beyond all praise.

SOUTH AFRICAN FORCE.

Capt. Maurice Bertram Lawrie, South African Medical Corps.
For conspicuous gallantry and devotion to duty. At great personal risk he established and carried on an advanced bearer post. He gave a fine example of courage to those under him in the case of heavy shell fire in clearing the forward area of wounded.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Distinguished Conduct Medal to the undermentioned Officer, Non-Commissioned Officers and Men :—

No. 9037 Capt. R. Treglown, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He remained out with a wounded man during an intense enemy bombardment. His devotion to duty had the most inspiring effect on all ranks.

No. 37443 Serjt. J. Ellis, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty, in leaving a trench at great personal risk to rescue two men who had been wounded by enemy snipers at close range. He was steadily fired upon the whole time. One of the men was hit a second time and killed before he could be brought to safety. (D.C.M. gazetted October 20, 1916.)

No. 844 Serjt. B. D. Johnstone, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty on many occasions in rescuing and attending to wounded at great personal risk. Since the beginning of the War he has shown great courage and devotion in volunteering over and over again for work involving difficulty and danger.

No. 38791 Pte. M. Thornton, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in crossing the open under direct fire to bring a stretcher to a wounded officer. He succeeded in doing this unaided, and was directly responsible for the officer's safety. Later, he returned again and again to an exposed position and carried in the wounded unaided. His example was magnificent. (D.C.M. gazetted November 25, 1916.)

No. 65147 Pte. O. P. G. Fiori, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He went out with the attacking party and carried in wounded all night. He was wounded, but continued his work until wounded a second time. He worked under continuous shell fire.

No. 340197 Pte. G. A. Walton, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He tended the wounded under heavy fire. His devotion to duty saved many lives.

War Office,
July 27, 1917.

The names of the undermentioned have been brought to the notice of the Secretary of State for War for distinguished services rendered in connexion with the War:—
Temp. Lieut.-Col. W. N. Barron, M.V.O., Royal Army Medical Corps.

Hon. Col. C. J. Bond, Consulting Surgeon. Northern Command.
Lieut.-Col. J. M. Cotterill, M.B., F.R.C.S., Royal Army Medical Corps.
Surg. Lieut.-Col. Sir W. R. Crooke-Lawless, Knt., C.B.. C.I.E., M.D., Reserve of Officers.
Surg.-Gen. J. C. Culling, Army Medical Service.
Temp. Col. J. Galloway, C.B., M.D., F.R.C.P., F.R.C.S., Army Medical Service.
Major and Bt. Lieut.-Col. (Temp. Brig.-Gen.) A. C. Geddes, C.B., M.D., Unattached List (T.F.).
Temp. Hon. Lieut.-Col. M. H. Gordon, C.M.G., M.D., Royal Army Medical Corps.
Lieut.-Col. D. Harvey, C.M.G., M.D., Royal Army Medical Corps.
Major G. A. D. Harvey, C.M.G., Royal Army Medical Corps.
Col. (Temp. Surg.-Gen.) R. S. F. Henderson, M.B., K.H.P., Army Medical Service.
Surg.-Lieut.-Col. and Hon. Surg. Col. D. Hepburn, M.D.,Royal Army Medical Corps.
Lieut.-Col. H. Littlewood, F.R.C.S., Royal Army Medical Corps.
Col. Sir J. Magill, K.C.B., M.D. (retired pay).
Temp. Lieut.-Col. W. L. W. Marshall, Royal Army Medical Corps.
Major P. S. O'Reilly, C.M.G., Royal Army Medical Corps.
Col. A. Peterkin, M.B. (retired pay), late Army Medical Service.
Surg.-Gen. R. H. Quill, M.B. (retired pay), late Army Medical Service.
Surg.-Lieut.-Col. (Hon. Surg. Colonel) R. J. Reece, C.B., M.D., H.A.C.
Temp. Major A. D. Reid, C.M.G., Royal Army Medical Corps.
Col. R. J. S. Simpson, C.M.G., M.B. (retired pay), Army Medical Service
Lieut.-Col. W. Turner (retired), Royal Army Medical Corps.
Col. C. R. Tyrrell, C.B. (retired pay), Army Medical Service.
Col. D. Wardrop, C.B., C.V.O., M.B. (retired pay), Army Medical Service.
Col. (Temp. Surg.-Gen.) M. T. Yarr, C.B., F.R.C.S.I., Army Medical Service.

War Office,
July 28, 1917.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-Commissioned Officer and Men:—

No. 41949 Serjt. A. E. Howson, Royal Army Medical Corps. (M.M's gazetted November 16th, 1916.)

No. 48981 Pte. W. James, Royal Army Medical Corps. (M.M's gazetted December 21. 1916.)

No. 67429 Pte. (Acting Sjt.) P. Pinder, Royal Army Medical Corps. (M.M's gazetted January 6, 1917.)

No. 337200 Pte. W. Wynn, Royal Army Medical Corps (formerly 1583). (M.M's gazetted March 12, 1917.)

His Majesty the King has been graciously pleased to award the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men:—

No. 5084 Serjt. S. B. Bawden, Royal Army Medical Corps.
No. 32028 Cpl. (Acting Serjt.) J. W. Bayliss, Royal Army Medical Corps.
No. 41385 Pte. J. Birchall, Royal Army Medical Corps.
No. 337333 Pte. F. Broadbent, Royal Army Medical Corps.
No. 70146 Pte. E. S. Dalley, Royal Army Medical Corps.
No. 48336 Pte. P. Davies, Royal Army Medical Corps.
No. 31516 Pte. G. Dewhurst, Royal Army Medical Corps.
No. 80808 Pte. E. Dingley, Royal Army Medical Corps.
No. 41527 Pte. (Acting Serjt.) F. Dutton, Royal Army Medical Corps.
No. 33799 Lance-Cpl. J. Fairbairn, Royal Army Medical Corps.
No. 54552 Pte. J. H. Feely, Royal Army Medical Corps.
No. 81204 Pte. H. Ferguson, Royal Army Medical Corps.
No. 301130 Serjt. A. K. Forbes, Royal Army Medical Corps.
No. 28243 Cpl. J. H. Garside, Royal Army Medical Corps.
No. 31500 Serjt. F. G. Gooch, Royal Army Medical Corps.
No. 40997 Cpl. J. E. Greenwood, Royal Army Medical Corps.
No. 52656 Pte. H. H. Griffin, Royal Army Medical Corps.
No. 41001 Serjt. R. Hall, Royal Army Medical Corps.
No. 39768 Pte. W. T. Harwood, Royal Army Medical Corps.
No. 37216 Pte W. V. Hughes, Royal Army Medical Corps.
No. 43035 Lance-Cpl. D. J. James, Royal Army Medical Corps.

No. 75531 Pte. E. A. Jones, Royal Army Medical Corps.
No. 43663 Pte. A. Macdonald, Royal Army Medical Corps.
No. 20054 Pte. R. Manning, Royal Army Medical Corps.
No. 50559 Pte. R. Marriott, Royal Army Medical Corps.
No. 17960 Serjt. T. McGuire, Royal Army Medical Corps.
No. 40842 Lance-Cpl. P. McKeown, Royal Army Medical Corps.
No. 337543 Pte. J. E. Moore, Royal Army Medical Corps.
No. 35959 Pte. J. B. Moss, Royal Army Medical Corps.
No. 74 Pte. D. Mullen, Royal Army Medical Corps.
No. 32406 Serjt. H. Naylor, Royal Army Medical Corps.
No. 40690 Pte. S. Oldham, Royal Army Medical Corps.
No. 10904 Lance-Cpl. C. Parker, Royal Army Medical Corps.
No. 39833 Pte. H. Poole, Royal Army Medical Corps.
No. 545702 Pte. (Acting Serjt.) H. Rayner, Royal Army Medical Corps.
No. 20008 Pte. R. Robbie, Royal Army Medical Corps.
No. 23882 Pte. C. A. Smith, Royal Army Medical Corps.
No. 39225 Serjt. C. E. Smith, Royal Army Medical Corps.
No. 563 Pte. C. H. Stevens, Royal Army Medical Corps (attached Wilts Regiment).
No. 37773 Pte. S. J. Thirkell, Royal Army Medical Corps.
No. 40073 Cpl. R. Tierney, Royal Army Medical Corps.
No. 38978 Serjt. R. Watts, Royal Army Medical Corps.
No. 6048 Pte. C. Wooderson, Royal Army Medical Corps.

His Majesty the King has been graciously pleased to award the Meritorious Service Medal to the undermentioned Man for gallantry in the performance of military duty:—

No. 104122 Pte. E. J. Spencer, Royal Army Medical Corps.

Lieut. (Temp. Capt.) Robert Ellis, M.B., Royal Army Medical Corps, Special Reserve, is now correctly described. (Awarded M.C., in *Gazette* dated June 4, 1917.)

Lord Chamberlain's Office,
St. James's Palace, S.W.
August 8, 1917.

The King has been graciously pleased to give orders for the following appointments to the Most Honourable Order of the Bath, for services rendered in connexion with the War, to be dated June 4, 1917:—

To be Additional Members of the Military Division of the Third Class, or Companions, of the said Most Honourable Order:—

Surg.-Gen. Richard Henry Quill, M.B., retired pay, late Army Medical Service.

Surg.-Gen. John Chislett Culling, Army Medical Service.

Col. Alfred Peterkin, M.B., retired pay, late Army Medical Service.

Col. (Temp. Surg.-Gen.) Robert Samuel Findlay Henderson, M.B., K.H.P., Army Medical Service.

Col. Robert John Shaw Simpson, C.M.G., M.B., retired pay, Royal Army Medical Corps.

Chancery of the Order of St. Michael and St. George,
Downing Street,
August 8, 1917.

The King has been graciously pleased to give directions for the following appointments to the Most Distinguished Order of St. Michael and St. George, in recognition of valuable services in connexion with the War. To be dated June 4, 1917:—

To be an Additional Member of the Second Class, or Knight Commander of the said Most Distinguished Order:—

Col. (Temp. Surg.-Gen.) Michael Thomas Yarr, C.B., F.R.C.S.I., Army Medical Service.

To be Additional Members of the Third Class, or Companions, of the said Most Distinguished Order:—

Lieut.-Col. William Turner, retired, Royal Army Medical Corps.

Lieut.-Col. Joseph Montagu Cotterill, M.B., F.R.C.S., Royal Army Medical Corps.

Surg. Lieut.-Col. and Hon. Surg.-Col. David Hepburn, M.D., Royal Army Medical Corps.

Lieut.-Col. Harry Littlewood, F.R.C.S., Royal Army Medical Corps.

Lieut.-Col. George Spiers Alexander Ranking, M.D., Royal Army Medical Corps.
Temp. Lieut.-Col. Willie Netterville Barron, M.V.O., Royal Army Medical Corps.
Lieut.-Col. James Currie Robertson, C.I.E., M.B., Indian Medical Service.
Temp. Lieut.-Col. William Lawrence Wright Marshall, Royal Army Medical Corps.

NEW ZEALAND FORCE.

Lieut.-Col. Bernard Ehrenfried Myers, M.D.
Major (Temp. Lieut.-Col.) Hugh Thomas Dyke Acland, F.R.C.S.
Major (Temp. Lieut.-Col.) David Storer Wylie, M.B., F.R.C.S.

HOME SERVICE.

War Office,
August 8, 1917.

His Majesty the King has been graciously pleased to approve of the undermentioned Rewards for valuable services rendered in connexion with the War, with effect from June 3, 1917, inclusive :—

TO BE BREVET COLONEL.

Lieut.-Col. C. Averill, M.D., Royal Army Medical Corps.
Lieut.-Col. H. L. Battersby, (retired pay), Royal Army Medical Corps.
Brig. Surg. Lieut.-Col. J. F. Beattie, M.D. (Retired List), Army Medical Staff.
Lieut.-Col. J. P. Bush, C.M.G., Royal Army Medical Corps.
Lieut.-Col. H. Charlesworth, C.M.G. (retired pay), Royal Army Medical Corps.
Lieut.-Col. C. P. Childe, F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. A. M. Connell, F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. H. E. Deane (retired pay), Royal Army Medical Corp.
Lieut.-Col. A. Dodd (retired pay), Royal Army Medical Corps.
Lieut.-Col. A. B. Gemmel, Royal Army Medical Corps.
Lieut.-Col. T. Gowans, M.B., Royal Army Medical Corps.
Lieut.-Col. L. K. Harrison, M.B., Royal Army Medical Corps.
Lieut.-Col. H. P. Hawkins, M.D., Royal Army Medical Corps.
Lieut.-Col. T. H. Haydon, M.B., Royal Army Medical Corps.
Lieut.-Col. A. G. Kay, M.B. (retired pay), Royal Army Medical Corps.
Lieut.-Col. J. R. Kaye, M.B., Royal Army Medical Corps.
Lieut.-Col. J. Marnoch, C.V.O., M.B., Royal Army Medical Corps.
Lieut.-Col. F. Marsh, F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. W. J. Maurice, M.B., Royal Army Medical Corps.
Lieut.-Col. R. R. H. Moore (retired pay), M.D., Royal Army Medical Corps.
Lieut.-Col. and Hon. Surg. Col. A. Napier, M.D., Royal Army Medical Corps.
Lieut.-Col. D. V. O'Connell, M.D. (retired pay), Royal Army Medical Corps.
Lieut.-Col. S. P. Phillips, M.D., Royal Army Medical Corps.
Lieut.-Col. J. A. Rooth, Royal Army Medical Corps.
Lient.-Col. J. W. Smith, M.B., F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. C. J. W. Tatham (retired pay), Royal Army Medical Corps.
Lieut.-Col. H. J. Waring, M.B., F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. H. W. Webber, F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. F. H. Westmacott, F.R.C.S., Royal Army Medical Corps.
Lieut.-Col. W. H. White, M.D., Royal Army Medical Corps.
Lieut.-Col. G. S. Woodhead, M.D., Royal Army Medical Corps.

TO BE BREVET LIEUTENANT-COLONEL.

Major T. D. Acland, M.D., Royal Army Medical Corps.
Major D. T. Bolding, Royal Army Medical Corps.
Major H. A. Berryman (retired pay), Reserve of Officers, late Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) R. A. Bolam, M.D., Royal Army Medical Corps.
Major C. R. Browne, M.D., Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) W. Butler, M.B., Royal Army Medical Corps.
Major A. Butler-Harris, M.B., Royal Army Medical Corps.
Major J. H. Drysdale, M.D., Royal Army Medical Corps.
Major C. H. Fagge, M.B., F.R,C.S., Royal Army Medical Corps,
Major T. A. M. Forde, Royal Army Medical Corps.
Major T. Forrest, M.B., Royal Army Medical Corps.

Major C. E. P. Fowler, F.R.C.S. (retired pay), Reserve of Officers, late Royal Army Medical Corps.
Major W. M. Gabriel, Royal Army Medical Corps.
Major J. W. Gill, M.D., Royal Army Medical Corps.
Major H. W. Laing, M.D., Royal Army Medical Corps.
Major F. W. Lamballe, M.B., Royal Army Medical Corps.
Surg.-Major R. E. Lauder. Royal Army Medical Corps.
Major (Acting Lieut.-Col.) C. A. Lees, Royal Army Medical Corps.
Major A. P. Luff, M.D., Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) A. B. Prowse, M.D., F.R.C.S., Royal Army Medical Corps.
Major D. Rennet, M.D., Royal Army Medical Corps.
Major B. M. H. Rogers, M.D., Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) C. Rundle, M.D., Royal Army Medical Corps.
Major J. E. H. Sawyer, M.D., Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) J. Smart, M.B., Royal Army Medical Corps.
Major H. Stott, Royal Army Medical Corps.
Major D. Wallace, C.M.G., M.B., F.R.C.S., Royal Army Medical Corps.
Major G. W. Watson, M.D., Royal Army Medical Corps.
Major F. E. A. Webb, Royal Army Medical Corps.
Major J. Wilson, M.B., Royal Army Medical Corps.

To be Brevet Majors.

Capt. S. T. Beggs, M.B., Reserve of Officers, Royal Army Medical Corps.
Capt. J. A. Bennett, M.B., Royal Army Medical Corps.
Capt. (Temp. Major) W. C. Bosanquet, M.D., Royal Army Medical Corps.
Capt. (Temp. Major) D. W. Boswell, M.D., Royal Army Medical Corps.
Capt. C. R. Box, M.D., F.R.C.S., Royal Army Medical Corps.
Capt. R. C. Elmslie, F.R.C.S., Royal Army Medical Corps.
Capt. J. Ewing, Royal Army Medical Corps.
Capt. J. Fawcett, M D., F.R.C.S., Royal Army Medical Corps.
Capt. (Temp. Lieut.-Col.) E. H. Fenwick, F.R.C.S.
Capt. (Temp. Major) E. S. Forde, Royal Army Medical Corps.
Capt. (Temp. Major) R. L. Guthrie, M.D., Royal Army Medical Corps.
Capt. W. Guy, F.R.C.S., Royal Army Medical Corps.
Capt. H. F. Horne, M.D., Royal Army Medical Corps.
Capt. J. L. Joyce, F.R.C.S., Royal Army Medical Corps.
Capt. (Temp. Major) H. A. Leebody, M.B., Royal Army Medical Corps.
Capt. J. N. McLaughlin, M.D., Royal Army Medical Corps.
Capt. A. W. Ormond, F.R.C.S., Royal Army Medical Corps.
Capt. (Temp. Lieut.-Col.) H. M. Rigby, M.B., F.R.C.S., Royal Army Medical Corps.
Capt. C. W. Rowntree, M.B., F.R.C.S., Royal Army Medical Corps.
Capt. A. Sellers, Royal Army Medical Corps.
Capt. H. Sharpe, Royal Army Medical Corps.
Capt. E. G. Smith, Royal Army Medical Corps.
Capt. N. W. Stevens, M.B., Royal Army Medical Corps.
Capt. H. H. Taylor, F.R.C.S., Royal Army Medical Corps.
Capt. A. Walker, Royal Army Medical Corps.
Capt. T. H. Ward, M.D., Royal Army Medical Corps.
Capt. W. J. Wilson, M.B., Royal Army Medical Corps.

To be Honorary Majors.

Qmr. and Hon. Capt. J. Wilson, Royal Army Medical Corps.

To be Honorary Captains.

Qmr. and Hon. Lieut. G. E. Barfield, Royal Army Medical Corps.
Qmr. and Hon. Lieut. E. C. Bennison, Royal Army Medical Corps.
Qmr. and Hon. Lieut. L. N. Blake, Royal Army Medical Corps.
Qmr. and Hon. Lieut. T. J. Spratley, Royal Army Medical Corps.
Qmr. and Hon. Lieut. J. C. Symonds, Royal Army Medical Corps,

War Office,
August 15, 1917.

The Secretary of State for War has received the following list of names of Officers, warrant and non-commissioned officers and men, ladies and civilians, whose services

have been brought to notice by Lieut.-Gen. Sir Stanley Maude, K.C.B., Commander-in-Chief, Mesopotamian Expeditionary Force, as deserving of special mention:—

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. W. M. Badenoch, M.B.
Capt. L. D. Bailey.
Temp. Capt. F. R. Barwell.
Capt. W. Bisset, M.B.
Lieut.-Col. J. H. R. Bond.
Capt. T. K. Boney, M.D. (Special Reserve).
Major A. N. Burgess, M.B., F.R.C.S.
Capt. E. T. Burke (Acting-Lieut.-Col.) M.B. (Special Reserve).
Temp. Capt. H. Cordner, M.B.
Capt. F. C. Cowtan.
Temp. Capt. R. D. Davy, M.B.
Capt. L. Dunbar, M.B.
Temp. Lieut. L. W. Evans.
Temp. Cap. R. C. T. Evans, M.B.
Bt. Col. M. H. G. Fell.
Temp. Capt. C. M. Geddie, M.B.
Temp. Capt. A. L. George.
Major (Acting-Lieut.-Col.) A. W. Gibson.
Capt. A. H. Gosse, M.D.
Capt. T. J. Hallinan, M.B.
Temp. Capt. J. Hewat, M.B.
Temp. Qmr. and Hon. Lieut. C. Hunt.
Temp. Lieut. D. H. Hutchinson, M.D.
Temp. Lieut.-Col. T. P. Legg, M.B., F.R.C.S.
Temp. Capt. J. Macqueen, M.B.
Temp. Capt. E. W. S. Martin, M.B. (killed).
Capt. J. S. McCombe, M.B.
Capt. W. McNaughtan, M.B.
Bt. Major T. J. Mitchell, M.B.
Temp. Qmr. and Hon. Lieut. J. S. Moore.
Capt. W. K. Morrison, M.B.
Lieut.-Col. (Acting..Col.) H. M. Morton, M.B.
Temp. Lieut. J. Neligan, M.B. (deceased).
Lieut.-Col. A. R. O'Flaherty.
Lieut. (Temp. Capt.) Patterson, A.F.I.
Capt. D. C. Pim, M.B. (Special Reserve).
Temp. Capt. G. Robinson.
Major D. S. Skelton, D.S.O.
Bt. Col. J. M. Sloan, M.B., D.S.O.
Capt. E. P. A. Smith, M.B.
Capt. G. N. Smyth, Special Reserve.
Temp. Capt. G. W. Spencer, M.B.
Temp. Capt. G. W. Stanley.
Col. W. H. Starr, A.M.S.
Temp. Capt. N. Tattersall, M.D.
Lieut. (Temp. Capt.) R. R. Thompson.
Capt. (Acting-Lieut.-Col.) W. J. Tobin.
Major N. D. Walker, M.B.
Temp. Qmr. and Hon. Lieut. G. B. Walker, M.C,
Capt. A. Watson, D.S-O., M.D.
Temp. Col. W. H. Wilcox, C.B., C.M.G., M.D., F.R.C.P., A.M.D.
Temp. Capt. D. Mc.D. Wilson, M.B.
Lieut.-Col. L. Wood.
Lieut.-Col. W. A. Woodside.

War Office,
August, 16, 1917.

His Majesty the King has been graciously pleased to award a Bar to the Distinguished Service Order to:—

Capt. Eric Dalrymple Gairdner, D.S.O., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He went forward under very heavy fire to attend to a wounded N.C.O., and was himself shot down. He has con-

sistently displayed high courage and devotion to duty, and his example has been an inspiration to all ranks (D.S.O., gazetted June 3, 1916).

His Majesty the King has been graciously pleased to approve of the appointment of the undermentioned Officers to be Companions of the Distinguished Service Order in recognition of their gallantry and devotion to duty in the field:—

Temp. Capt. (Acting Lieut.-Col.) Charles Derwent Pye-Smith, M.C., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. When in charge of an advanced dressing station his Serjt.-Major and the whole of his staff were killed. He re-organized the work with the assistance of a Lance-Corporal, and, in consequence of his energy and presence of mind, the work was not delayed. He led his bearers continually into the front line, rescuing wounded under heavy shell fire, and working with great heroism for sixty hours, setting a splendid example to all.

NEW ZEALAND FORCE.

Lieut.-Col. (Temp. Col.) Donald Johnstone McGavin, Medical Corps.

For conspicuous gallantry and devotion to duty. While acting as A.D.M.S. to his division the successful evacuation of the wounded during our heavy offensive was due to the thoroughness of his preparations and his personal attention to the smallest details. He went into the advanced area at great personal risk to encourage the stretcher-bearers and superintend the removal of casualties, setting a splendid example to all ranks.

His Majesty the King has been graciously pleased to award a Bar to the Military Cross to the undermentioned officers:—

Capt. Samuel Russell Foster, M.C., M.B., Royal Army Medical Corps,

For conspicuous gallantry and devotion to duty. He showed the greatest skill and fearlessness in leading his stretcher-bearers through a severe enemy barrage to evacuate wounded from our front line. His work has always been marked by utter disregard of danger, and his fine example has communicated itself to his men (M.C., gazetted November 18, 1915).

Temp. Capt. David Hamilton Hadden, M.C., M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. Under extremely adverse weather conditions he worked without rest for three nights and two days attending wounded. Throughout he showed the utmost indifference to heavy shell and machine-gun fire. (M.C. gazetted January 1, 1917.)

Capt. Frank Grahame Lescher, M.C., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty. He showed the greatest skill and fearlessness by leading his bearer parties and establishing forward collecting posts, under heavy hostile shell fire. He worked ceaselessly for three days, by his personal example and devotion inspiring his men with courage under very difficult conditions. (M.C. gazetted October 20, 1916.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers and Warrant Officers in recognition of their gallantry and devotion to duty in the Field:—

Temp. Lieut. Ernest Francis Rimington Alford, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He has on all occasions shown the greatest courage and disregard for danger when attending wounded under fire, and in many cases in the open.

Temp. Capt. Charles Bannigan, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. A dug-out having been blown in at some distance from his aid post he ran to the spot at great personal risk under heavy shell fire and attended to the wounded, saving one man's life. His conduct on all occasions has been marked by the greatest courage and devotion.

Temp. Capt. David Sands Brough, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked unceasingly when in charge of two bearer sub-divisions. Under very heavy fire he again and again led his bearers to the wounded, setting a fine example to all.

Capt. John Cook, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He went out under heavy shell fire, attending to the wounded and carrying them to cover, and setting a fine example of fearlessness and devotion.

Capt. Alexander Cosgrave Court, M.B., Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty in establishing an advanced aid post and personally attending to all the wounded under heavy fire. Though wounded in the hand, he carried on, saving many lives and showing great courage and initiative on this as on all other occasions.

Temp. Capt. Eric William Craig, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. During the night he repeatedly led the bearers beyond our front line under heavy fire. By his example and courage he was the means of rescuing many wounded.

Capt. Harry Edmund Cresswell, Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty. When casualties were very heavy he worked single-handed for thirty-six hours without rest. Throughout he showed complete disregard for his own personal safety.

Temp. Capt. Alexander Dick, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion when in medical charge of the regiment during an attack. He was forced to establish his aid post in an open trench, where he carried out his duties for two days and one night under heavy shell fire and in terrible weather. He never left his post, except to attend to wounded, who could not be brought in, and it was owing to his energy and heroism that the wounded were safely removed from the battlefield.

Capt. William Fotheringham, M.B., Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty. Finding no suitable position for an aid post in the captured lines, he established one in an open trench, where he attended to the wounded for four days and nights under constant shell and gas attack. His courage and devotion set a fine example to all those working under him.

Capt. Charles Marsh Goznev, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in attending to the wounded under heavy shell fire. By his courage and total disregard of personal danger he set a brilliant example to all around him and greatly encouraged the wounded.

Temp. Capt. Ernest Eugene Herga, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When in command of an advanced bearer post, he displayed the greatest gallantry and skill in bringing the wounded through heavy hostile barrage, twice crossing the open under machine-gun fire to rescue wounded men. By his skilful organization and great personal courage under fire the evacuation of the wounded was efficiently carried out.

Temp. Capt. Hugh Ross Macintyre, M.D., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in command of a bearer party. He led his men repeatedly through heavy hostile barrage until all the wounded had been carried into safety. He was fearless in the place of danger, and by his coolness and courage he showed a splendid example to his men.

Capt. Laurence Abel Mackenzie, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. Whilst at work in a dressing station a shell came through two roofs, killing and wounding five out of his party of six. Though severely shaken himself he organized the dressing station and carried on with the work under very heavy shell fire for two days, showing a magnificent example of grit, courage and devotion to duty under exceptionally trying circumstances.

Temp. Lieut. Robert Beattie Martin, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He showed the greatest gallantry in attending to the wounded under very heavy fire at a moment when the enemy had turned machine-guns on to them. He displayed the utmost fearlessness and skill in getting most of them away into a place of safety.

Temp. Capt. James McDonnell, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When the village was being shelled, a number of men were buried and badly wounded. He superintended a party

and worked for three-quarters of an hour, and succeeded in rescuing them. This task was carried out under continuous shelling.

Temp. Capt. Thomas Holmes Ravenhill, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in collecting and evacuating wounded under heavy shell fire, notably during a gas attack when his coolness and judgment saved very many casualties.

Temp. Capt. David Henry Russell, M.D., F.R.C.S., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of a bearer division. He showed the greatest energy and complete disregard for personal safety in his untiring and successful efforts to locate the wounded and to attend to them. His devotion saved many lives, and on many occasions he has displayed the same gallantry under fire.

Capt. John Fox Russell, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He showed the greatest courage and skill in collecting wounded men of all regiments, and in dressing them, under continuous shell and rifle fire.

Temp. Capt. Laurence Lancaster Satow, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He established a dressing station within effective range of the enemy's position, where he attended to the wounded throughout the day and the following night under fire the whole time. It was entirely owing to his disregard of danger and his devotion to duty that many of the wounded were collected and evacuated.

Capt. Henry Joste Smith, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He followed his battalion in the attack, and attended to the wounded all day and night under very heavy fire of every description. It was due to his courage and splendid devotion that so many of the wounded were brought in.

Capt. Ernest Talbot, M.B., Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty as battalion medical officer. Having established his aid post in a shell-hole which was under direct hostile observation, he carried out his work under very heavy fire, showing wonderful organization in his evacuation of the wounded.

Capt. Robert Taylor, Royal Army Medical Corps, Special Reserve.
For conspicuous gallantry and devotion to duty in establishing bearer posts and an advanced dressing station under heavy shell fire. It was due to his excellent arrangements that all the wounded were attended to and evacuated with the utmost regularity and dispatch.

Lieut. Arthur Gerald Phillips Wills, Royal Army Medical Corps, Special Reserve, attached Cheshire Regiment.
For conspicuous gallantry and devotion to duty. He remained at his aid post under heavy shell fire for eighteen hours without rest, by his gallantry and fine example encouraging his bearers to work continuously, until the last case was safely evacuated.

Assist. Surg. John Wilson Woodsell, I.S.M.D.
For conspicuous gallantry and devotion to duty. He displayed great courage and determination in tending the wounded under very heavy fire. His devotion to duty saved many lives.

41008 Serjt.-Major Thomas Harland, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. An ammunition train having caught fire, he and four other men uncoupled and pushed out of danger eight trucks of ammunition. This gallant work was performed amidst a hail of shells and fragments, owing to the ammunition in the ninth truck exploding. At any moment the contents of the remaining trucks might have done likewise. He displayed splendid fearlessness and promptitude in dealing with a very dangerous and critical situation.

AUSTRALIAN IMPERIAL FORCE.

Capt. Noel Edmund Barton Kirkwood, Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked continuously for ninety hours attending wounded under heavy shell fire. He set a most inspiring example to those around him.

Canadian Force.

Capt. Gordon Archibald Macpherson, Army Medical Corps.
For conspicuous gallantry and devotion to duty in collecting and tending the wounded under heavy shell fire. His promptness and devotion in collecting stretcher cases in dug-outs when it was impossible to evacuate them at once undoubtedly saved many lives.

Capt. Archibald McCausland, Army Medical Corps.
For conspicuous gallantry and devotion to duty. At great personal risk he crawled through a small opening into a dug-out which had been blown in by hostile shell fire, dressed the men there, and afterwards attended to all the wounded in the locality under continuous heavy shell fire. His courageous action saved the lives of several wounded men.

Capt. Andrew Harvey Cameron Smith, Army Medical Corps.
For conspicuous gallantry and devotion to duty. Following his battalion closely in its attack he displayed the greatest courage and skill in establishing aid posts at the nearest possible points, regardless of his own personal safety. Though his posts were frequently under heavy fire the completeness of his medical arrangements, and the quickness with which aid was available, proved invaluable to the wounded. His work at all times has been marked by the same devotion and gallantry.

New Zealand Force.

Capt. Arthur Stanley Addison, Medical Corps.
For conspicuous gallantry and devotion to duty. During an attack he established his dressing station and worked with the greatest devotion under heavy shell fire, successfully dealing with a great many wounded from all units in his vicinity.

Capt. William Aitken, Medical Corps.
For conspicuous gallantry and devotion to duty. He repeatedly took his bearers through heavy hostile barrage, clearing the aid posts and searching shell-holes for wounded. His gallantry and coolness under fire was of the highest order and a splendid example to his men.

Capt. James Garfield Crawford, Medical Corps.
For conspicuous gallantry and devotion to duty. He repeatedly took his bearers through heavy barrage, bringing back many wounded who were lying exposed to the enemy's fire. His coolness and fearlessness under heavy fire was a striking example to his men, and his energy was the direct cause of many lives being saved.

Capt. Arthur Dysant Nelson, Medical Corps.
For conspicuous gallantry and devotion to duty. He remained for three days continuously on duty under very heavy shell fire, attending to the wounded of his own and many other units. Owing to his advanced position and untiring energy many lives were saved.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Warrant Officers, Non-commissioned Officers and Men, for acts of gallantry and devotion to duty in the Field:—

No. 40658 Cpl. (Acting Sergt.) H. Goodwin, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He showed the utmost fearlessness and untiring energy in supervising the collection of wounded from various parts of the battlefield, doing magnificent work under heavy fire of every description. He refused to be relieved until all the wounded had been brought in.

No. 477061 (formery 1855) Cpl. T. C. Main, Royal Army Medical Corps, attached Essex Regiment.
For conspicuous gallantry and devotion to duty. He dressed the wounds under heavy fire and continued to work during the whole of the night and the following day, giving the greatest assistance to the medical officer.

No. 58957 Pte. (Acting Lance-Cpl.) F. W. Medley, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of bearing squads and an advanced pressing station. Though under very heavy shell-fire, he worked untiringly for sixty hours, displaying splendid resource and power of organization in

attending to the evacuation of the wounded. This he successfully accomplished, showing complete disregard for his personal safety throughout.

No. 320006 (formerly 327) Serjt. A. Messer, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When in charge of stretcher parties he displayed exceptional fearlessness and energy in rescuing wounded from positions of great danger. This entailed four hours' work over extremely difficult country under constant fire. He was completely exhausted at the finish.

No. 15289 Serjt. (Acting Staff Serjt.) H. R. M. Rodman, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He collected wounded in the open and organized his stretcher-bearers all day and night under heavy fire.

No. 419024 Staff-Serjt. J. H. Wakeling, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When in charge of reserve stretcher-bearers he took them up to the forward trenches under heavy shell fire and brought them back through the enemy barrage with the utmost coolness. His indifference to danger kept his bearers together and brought them safely through the barrage. His untiring energy and personal supervision has on all occasions had a most encouraging effect on his bearers.

No. 6756 Serjt. F. Wheatley, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. During the night he led his bearers over difficult ground under heavy fire, and by daylight he made repeated journeys to our advanced positions under heavy fire to bring back wounded.

No. 368214 (formerly 2042) Serjt. B. J. Wilkie, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in organizing and supervising clearing parties to bring in the wounded. By his fine example and untiring energy he greatly aided the removal of wounded from our front.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officers and Men:—

No. 534039 Serjt. A. H. Robson, Royal Army Medical Corps (formerly 1257). (M.M. gazetted June 3, 1916.)

No. 7533 Pte. (Acting Cpl.) V. H. Andrews, Royal Army Medical Corps. (M.M. gazetted September 15, 1916.)

No. 8650 Pte. W. Casewell, Royal Army Medical Corps. (M.M. gazetted October 11, 1916.)

No. 10647 Cpl. F. W. Bond, Royal Army Medical Corps. (M.M. gazetted December 21, 1916.)

No. 63805 Pte. H. Brooker, Royal Army Medical Corps. (M.M. gazetted January 6, 1917.)

No. 301130 Serjt. A. K. Forbes, Royal Army Medical Corps. (M.M. gazetted July 28, 1917.)

His Majesty the King has been graciously pleased to award the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men:—

No. 22426 Pte. W. Affleck, Royal Army Medical Corps.
No. 354079 Pte. C. Barker, Royal Army Medical Corps.
No. 51025 Pte. (Acting Serjt.) J. F. Bayliss, Royal Army Medical Corps.
No. 89459 Pte. F. Benger, Royal Army Medical Corps.
No. 388444 Lance-Cpl. A. P. Clegg, Royal Army Medical Corps.
No. 534056 Pte. P. H. Cox, Royal Army Medical Corps.
No. 536567 Cpl. T. R. Cutting, Royal Army Medical Corps.
No. 663490 Pte. E. Donnelly, Royal Army Medical Corps.
No. 45404 Lance-Cpl. W. J. Gibson, Royal Army Medical Corps.
No. 49874 Serjt. H. P. Hunt, Royal Army Medical Corps.
No. 49892 Pte. (Acting Serjt.) W. Kirwin, Royal Army Medical Corps.
No. 88102 Pte. G. Lumsden, Royal Army Medical Corps.
No. 558255 Pte. H. McCabe, Royal Army Medical Corps.
No. 41070 Cpl. F. McCann, Royal Army Medical Corps.
No. 41216 Pte. W. McKay, Royal Army Medical Corps,
No. 536354 Pte. S. T. Millsom, Royal Army Medical Corps.
No. 36194 Pte. S. Nicoll, Royal Army Medical Corps.
No. 44788 Pte. J. Oliver, Royal Army Medical Corps.

No. 341498 Pte. A. Owen, Royal Army Medical Corps.
No. 53800 Serjt. E. Palmer, Royal Army Medical Corps.
No, 65184 Pte. R. D. Pearson, Royal Army Medical Corps.
No. 538099 Pte. W. Rock, Royal Army Medical Corps.
No. 341364 Serjt. A. Stevenson, Royal Army Medical Corps.
No. 536377 Pte. E. Swinscoe, Royal Army Medical Corps.
No. 497513 Lance-Cpl. H. H. R. Vann, Royal Army Medical Corps.
No. 434295 Pte. H. T. Welsh, Royal Army Medical Corps.
No. 538292 Pte. R. L. White, Royal Army Medical Corps.
No. 386030 Serjt. G. W. Wright, Royal Army Medical Corps.

His Majesty the King has been graciously pleased to award the Meritorious Service Medal to the undermentioned Non-commissioned Officers in recognition of valuable services rendered with the Armies in the Field during the present War:—

No. 36555 Qmr. Serjt. H. J. Stark, Royal Army Medical Corps.
No. 35569 Serjt. Major B. T. Stone, Royal Army Medical Corps.

AMENDMENT.

The following is a correct description of a Non-commissioned Officer, upon whom a reward has recently been conferred:—

No. 9007 Cpl. R. Treglown, Royal Army Medical Corps. (D.C.M. gazetted July 26, 1917.)

ROYAL ARMY MEDICAL CORPS FUND.

THE Secretary, Royal Army Medical Corps and Auxiliary Funds, begs to acknowledge with thanks the receipt of donations from the Officers of No. 4 Stationary Hospital, France, as under: Royal Army Medical Corps Fund, 200 francs; Auxiliary Royal Army Medical Corps Fund, 300 francs.

124, *Victoria Street.*
September 14, 1917.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, *Serle Street, London, W.C., not later than thc 22nd of the month.*

———

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of Excerpts*	Extra for Covers for Reprints: As Journal, Printed on Front	Extra for Covers for Reprints: As Journal, Plain, Unprinted	Extra for Covers for Reprints: Cheaper Paper, Printed on Front	Extra for Covers for Reprints: Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2				
	8	0 5 0	0 2 3	4 3	1 1	3 10	0 9
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5				
	8	0 6 0	0 2 9	4 10	1 6	4 4	0 11
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10				
	8	0 7 6	0 3 6	6 0	2 1	4 10	1 2
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1				
	8	0 10 0	0 4 10	7 10	3 11	6 7	2 5
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5				
	8	0 15 0	0 6 7	10 10	7 6	9 0	4 10
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. net; binding, 2s.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 324, Adastral House, Victoria Embankment, E.C. 4.

Communications have been received from Majors C. S. McVicar, F. B. Jefferies; Captains A. T. Nankivell, H. J. Norman, A. H. Coleman, W. T. Tyndall, J. H. M. Frobisher, C. E. Sundell.

The following publications have been received:—

British: Public Health, The Medical Journal of Australia, The Medical Press and Circular, The Indian Medical Gazette, The Journal of Tropical Medicine and Hygiene, Guy's Hospital Gazette, The Hospital, St. Bartholomew's Hospital Journal, Proceedings of the Royal Society of Medicine, The Army Service Corps Journal.

Foreign: Bulletin of the Johns Hopkins Hospital, Bulletin de l'Institut Pasteur, Colonies et Marine, Archives Médicales Belges, Giornale de Medicina Militare, L'Ospedale Maggiore.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

THE HON. MANAGER,
"JOURNAL OF THE ROYAL ARMY MEDICAL CORPS,"
25, ADASTRAL HOUSE, VICTORIA EMBANKMENT, E.C. 4.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

OCTOBER, 1917.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
August 21, 1917.

His Majesty the King has been graciously pleased to award the Military Medal for bravery in the Field to the undermentioned Non-commissioned Officers and Men:—

No. 642 Pte. J. H. Benjamin, Royal Army Medical Corps.
No. 8946 Pte. F. A. Black, Royal Army Medical Corps.
No. 8338 Pte. J. Booth, Royal Army Medical Corps.
No. 473012 Pte. S. Bowles, Royal Army Medical Corps.
No. 66123 Pte. E. S. Buckley, Royal Army Medical Corps.
No. 23776 Cpl. R. Carruthers, Royal Army Medical Corps.
No. 101565 Pte. J. R. Cook, Royal Army Medical Corps.
No. 90001 Serjt. E. Cox, Royal Army Medical Corps.
No. 30283 Pte. P. Curtin, Royal Army Medical Corps.
No. 23955 Pte. W. Doughty, Royal Army Medical Corps.
No. 457355 Cpl. (Lance-Serjt.) G. E. Essex, Royal Army Medical Corps.
No. 37526 Pte. (Acting Serjt.) G. H. Frazer, Royal Army Medical Corps.
No. 300 Pte. G. T. Goble, Royal Army Medical Corps.
No. 419404 Pte. R. E. Johnson, Royal Army Medical Corps.
No. 419224 Pte. W. Johnson, Royal Army Medical Corps.
No. 76716 Pte. G. L. Jolly, Royal Army Medical Corps.
No. 350072 Pte. W. B. Lisett, Royal Army Medical Corps.
No. 41846 Pte. W. Mancey, Royal Army Medical Corps.
No. 41760 Pte. W. Marsh, Royal Army Medical Corps.
No. 40335 Pte. W. A. Morley, Royal Army Medical Corps.
No. 419008 Staff-Serjt. H. W. Neal, Royal Army Medical Corps.
No. 6965 Pte. E. R. Ness, Royal Army Medical Corps.
No. 58150 Pte. (Acting Cpl.) H. H. O'Connell, Royal Army Medical Corps.
No. 6332 Cpl. G. H. Parker, Royal Army Medical Corps.
No. 66999 Cpl. (Acting Serjt.) D. Peters, Royal Army Medical Corps.
No. 421215 Lance-Cpl. R. E. Potter, Royal Army Medical Corps.
No. 339115 Pte. J. Randall, Royal Army Medical Corps.
No. 419413 Pte. H. Roberts, Royal Army Medical Corps.
No. 10418 Pte. R. P. Street, Royal Army Medical Corps.
No. 538283 Pte. A. J. Stringer, Royal Army Medical Corps.
No. 73303 Pte. E. Walsh, Royal Army Medical Corps.
No. 73308 Pte. F. S. Walsh, Royal Army Medical Corps.
No. 1099 Cpl. (Acting Serjt.) A. Walton, Royal Army Medical Corps.
No. 73312 Pte. C. Walton, Royal Army Medical Corps.

War Office,
August 22, 1917.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign:—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS AND MEDALS PRESENTED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

Croix de Guerre.

Capt. Alfred Leopold Robertson, M.B., Royal Army Medical Corps, Special Reserve.
Temp. Capt. James William Edington, M.B., Royal Army Medical Corps.
Temp. Lieut. William McKee, M.B., Royal Army Medical Corps.
Capt. William Lombard Murphy, Royal Army Medical Corps.
Temp. Lieut. Douglas George Clutsom Tasker, M.B., Royal Army Medical Corps.
No. 66556 Pte. William George Bransgrove, Royal Army Medical Corps.
No. 81913 Pte. Thomas Idwal Davies, Royal Army Medical Corps.
No. 23622 Pte. Noel Elliott Green, Royal Army Medical Corps.
No. 79455 Pte. William Stewart, Royal Army Medical Corps.
No. 79712 Pte. Albert James Zimmer, Royal Army Medical Corps.

Corrections "London Gazette," 1917.

Page 5451 (June 2), Legion d'Honneur, Surg.-Gen. Eugene Fiset, Canadian Permanent Forces, and Lieut.-Col. Albert Edouard Le Bel, Canadian Army Medical Corps, *for* Croix de Chevalier *read* Croix de Commander.

War Office,
August 25, 1917.

His Majesty the King has been graciously pleased to approve of the appointments of the undermentioned Officers to be Companions of the Distinguished Service Order in recognition of their gallantry and devotion to duty in the Field:—

AUSTRALIAN IMPERIAL FORCE.

Major Rupert Iggulden Furber, Army Medical Corps.

For conspicuous gallantry and devotion to duty. He had charge of an advanced dressing station for five days, during which it was under heavy shell fire most of the time. He displayed the greatest ability and devotion to duty in organizing the dressing and evacuation of a large number of the wounded, on several occasions helping to bring them in himself.

Lieut.-Col. John Smith Purdy, Army Medical Corps.

For conspicuous gallantry and devotion to duty. Although continually under shell fire for seven days, he exercised close personal supervision over the evacuation of the wounded, and by his own example of courage and disregard of danger he animated all ranks with a similar attitude of mind. His work during preliminary preparations displayed the same untiring energy and devotion to duty.

His Majesty the King has been graciously pleased to award a Bar to the Military Cross to the undermentioned Officer:—

Temp. Capt. Ernest Harrison Griffin, M.C., M.D., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He showed the greatest gallantry in rescuing wounded men by night from "No Man's Land," where they had lain since dawn. He worked for four hours under heavy and continued shell fire, directing the bearers, encouraging and personally assisting the wounded, thereby enabling a large number of men to get back into our lines. Whilst thus employed, he went through the enemy's wire to within sixty yards of his position. His work has been excellent since he came out in 1914. (M.C. gazetted August 25, 1916.)

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers in recognition of their gallantry and devotion to duty in the Field:—

Temp. Lieut. George Errington Lloyd, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He went forward to a captured position on his own initiative, and established an aid post under shell fire, amongst

shell holes, where he rendered valuable assistance to the wounded and was always at hand when casualties occurred.

Temp. Capt. Charles James Lodge Patch, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in attending to a wounded officer in the front line and removing him to a place of safety. During the whole time he was under shell fire, by which he was wounded in two places, but disregarded his own wounds until those of the officer had been dressed. His devotion to duty and contempt of danger when under fire have been most marked on many occasions.

Temp. Lieut. Frank Gordon Pedley, M.D., Royal Army Medical Corps (Lieut. Canadian Army Medical Corps.)

For conspicuous gallantry and devotion to duty in proceeding to a dug-out, which had been hit by enemy shell fire, and saving the lives of many of the occupants. He afterwards went through a very heavy barrage to attend to a badly wounded officer, whom he eventually brought back to the dressing station. On both occasions he displayed the utmost gallantry and disregard of danger.

Temp. Capt. Laurence Cecil Sebastian Roche, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of forward stretcher bearers. He worked under an intense barrage fire with his bearers, collecting and successfully evacuating large numbers of wounded, throughout a continuous barrage of sixteen hours. His gallant conduct and personal disregard of all danger greatly inspired his men in the execution of their duty.

Temp. Capt. John Ross, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in remaining in the open from 6 a.m. to 9 p.m. dressing and attending the wounded of his own and other regiments under heavy shell fire. He then went to assist another unit whose medical officer had been wounded, and during the whole of the operations he set a splendid example of cheerfulness and boundless energy.

Temp. Lieut. John Edward Sandilands, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in leading his bearers forward under heavy barrage to evacuate wounded. He continued throughout the day to organize and superintend the removal of casualties under heavy shell fire.

Temp. Capt. John Ingram Shepherd, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in working unceasingly, day and night under heavy shell fire. The fire was so intense that many of the men he dressed were subsequently killed. His work was marked by the utmost courage and disregard of personal safety under extremely trying conditions.

Temp. Capt. Bernard Charles Tennent, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in continually exposing himself with the utmost fearlessness under heavy shell fire in order to visit his posts in the front trenches. He dressed many men in the open, regardless of personal danger, and when his bearers became casualties he took their places and assisted to carry the wounded himself.

Temp. Capt. Herbert George Willis, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in leading his men into the front line trenches to assist regimental stretcher-bearers. He was conspicuous in dressing the wounded under heavy fire, taking out a party and exposing himself with the utmost fearlessness, thereby ensuring all the wounded being removed to the aid posts.

Australian Imperial Force.

Capt. Jack Rowland Stanley Grose Beard, Army Medical Corps.

For conspicuous gallantry and devotion to duty on many occasions. He carried out his duties in attending to the wounded under the most trying and difficult circumstances under heavy enfilading artillery fire, afterwards refusing to leave his aid post, although it was blown in and he was buried. On the following day he went out into a hostile barrage and brought in two stretcher-bearers who had been wounded. At all times his fearless example had the most inspiring effect on his medical staff.

Capt. Wendell Inglis Clark, Army Medical Corps.

For conspicuous gallantry and devotion to duty. He remained on duty for nearly three days with only four hours' rest, attending to over 300 cases of wounded and working mostly under extremely heavy fire. On many previous occasions he has done excellent work whilst under fire, displaying the greatest courage and devotion.

Capt. Laurence Bedford Elwell, Army Medical Corps.

For conspicuous gallantry and devotion to duty. He personally organized, with great ability and entire disregard of his own safety, the evacuation of wounded along a route which was under direct enemy observation and subjected to heavy rifle and machine gun fire. On another occasion he twice visited an aid post under intense hostile barrage to assist the officer in charge, displaying, as on all other occasions, the utmost fearlessness and devotion to duty.

Capt. Raphael Leo Kenihan, Army Medical Corps.

For conspicuous gallantry and devotion to duty. He established the most forward regimental aid post in his division, where he attended to the wounded under heavy shell fire the whole time. Although himself slightly wounded and compelled to shift his post twice by hostile shell fire, he continued to attend all his cases with the greatest care and devotion, saving many lives by remaining in his forward position and setting a magnificent example.

Capt. Keith Shelley Parker, Army Medical Corps.

For conspicuous gallantry and devotion to duty. He went forward under heavy artillery and machine-gun fire, and established his aid post in a shell-hole, where he worked under most adverse conditions for five days without rest, attending the wounded of many units. He was under shell fire the whole time, and set a splendid example of devotion to duty.

Capt. Harold Powell, Army Medical Corps.

For conspicuous gallantry and devotion to duty in continually working under heavy fire and the most adverse conditions, with complete disregard for his personal safety. As medical officer he is invaluable to his battalion, not only in regard to his assistance in keeping the men medically and physically fit, but by his example of coolness, courage and good humour when under fire.

Capt. Fritz Peter Max Solling, Army Medical Corps.

For conspicuous gallantry and devotion to duty. Although under constant shell-fire for a fortnight, he continued to attend to the casualties of his own and of other units, on one occasion for a period of twenty-four hours without a break. During a heavy hostile gas attack he displayed the utmost devotion and disregard of danger.

Capt. Cedric William Whiting, Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of stretcher-bearers. He displayed the greatest ability in keeping touch with the aid post and in clearing the wounded, twice taking his bearers through a heavy barrage for that purpose. His pluck and determination were beyond all praise.

Capt. Roy Coupland Winn, Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of stretcher-bearers. He constantly patrolled the bearer line under very heavy shell fire, maintaining communication between aid posts and dressing stations, and on one occasion he took a squad across the open through an intense barrage to an aid post in order to relieve a temporary glut of wounded. He was twice wounded, the second time severely, and his gallant conduct was the means of saving many lives.

Capt. John Smythe Yule, Army Medical Corps.

For conspicuous gallantry and devotion to duty whilst under heavy shell fire. Although gassed early in the operation he remained continuously on duty for two days, during which time 450 cases passed through his hands. He has shown great gallantry on numerous previous occasions.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-commissioned Officer and Man, for acts of gallantry and devotion to duty in the Field:—

No. 10647 Pte. (Acting Cpl.) F. W. Bond, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty under a heavy gas and H.E. bombardment. With an officer he entered a dug-out and helped to bring out the occupants, working with the utmost energy and devotion until he too became unconscious from the effects of the gas. It was largely due to his gallantry that only two succumbed out of seven who were in the dug-out, and he has on many occasions displayed courage of the highest order, as well as very exceptional coolness and presence of mind.

No. 41669 Serjt. C. C. Johnstone, Royal Army Medical Corps.

Conspicuous gallantry and devotion to duty. He entered an ammunition dump that was under heavy shell fire in search of wounded. With heroic disregard of his

personal safety, and undeterred by flying débris and violent explosions, he removed and dressed a number of wounded men. He then went to a building that was ablaze, and rescued two more. As he got clear of the building it collapsed, exploding the ammunition stored inside. He personally saved several lives, that without his presence of mind must have been sacrificed, and his absolute fearlessness and devotion cannot be too highly praised.

CHANCERY OF THE ORDER OF ST. MICHAEL AND ST. GEORGE.

Downing Street,
August 25, 1917.

The King has been graciously pleased to give directions for the following appointments to the Most Distinguished Order of St. Michael and St. George, for services rendered in connexion with military operations in the Field in Mesopotamia, to be dated June 5, 1917 :—

To be Additional Members of the Third Class, or Companions, of the said Most Distinguished Order :—

Col. William Henderson Starr.
Lieut.-Col. and Brevet-Col. Matthew Henry Gregson Fell, Royal Army Medical Corps.
Lieut.-Col. and Brevet-Col. John Macfarlane Sloan, D.S.O., M.B., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) Charles Neil Campbell Wimberley, M.B., Indian Medical Service.
Lieut.-Col. Edward Victor Hugo, M.D., F.R.C.S., Indian Medical Service.
Lieut.-Col. (Temp. Col.) Walter Holland Ogilvie, M.B., Indian Medical Service.
Temp. Lieut.-Col. Thomas Percy Legg, M.B., F.R.C.S., Royal Army Medical Corps.

India Office,
August 25, 1917.

The King has been graciously pleased to make the following promotions in and appointments to the Most Eminent Order of the Indian Empire in recognition of the meritorious services of the undermentioned gentlemen in connexion with the War :—

To be Additional Companions of the said Most Eminent Order :—

Major David Munro, Indian Medical Service.
Lieut.-Col. Felix Oswald Newton Mell, Indian Medical Service.
Lieut.-Col. Bhola Nauth, Indian Medical Service.

War Office,
August 25, 1917.

His Majesty the King has been graciously pleased to approve of the undermentioned Rewards for Distinguished Service in the Field in Mesopotamia, dated June 3, 1917 :—

TO BE BREVET LIEUTENANT-COLONEL.

Major L. J. M. Deas, M.B., F.R.C.S., Indian Medical Service.
Major J. D. Graham, M.B., Indian Medical Service.
Major A. W. M. Harvey, M.B., Indian Medical Service.
Major H. M. H. Melhuish, Indian Medical Service.
Major D. S. Skelton, D.S.O., Royal Army Medical Corps.
Major T. S. B. Williams, M.B., Indian Medical Service.

TO BE BREVET MAJOR.

Capt. L. Dunbar, M.B., Royal Army Medical Corps.
Capt. L. H. L. Mackenzie, M.B., Indian Medical Service.
Capt. W. McNaughtan, M.B., Royal Army Medical Corps.

TO BE COMPANIONS OF THE DISTINGUISHED SERVICE ORDER.

Lieut.-Col. James Henry Robinson Bond, Royal Army Medical Corps.
Major and Brevet Lieut.-Col. George Browse, M.D., Indian Medical Service.
Capt. (Acting Lieut.-Col.) Edmund Tytler Burke, M.B., Royal Army Medical Corps, Special Reserve.
Major (Temp. Lieut.-Col.) Arthur Brownfield Fry, M.B., Indian Medical Service.
Major Samuel Robert Godkin, F.R.C.S.I., Indian Medical Service.
Capt. John Smith McCombe, M.B., Royal Army Medical Corps.

Capt. William Kenneth Morrison, M.B., Royal Army Medical Corps.
Lieut.-Col. (Acting Col.) Hugh Murray Morton, M B., Royal Army Medical Corps.
Lieut Col. Edmund Ludlow Perry, Indian Medical Service.
Capt. Douglas Chetham Pim, M.B., Royal Army Medical Corps, Special Reserve.
Lieut.-Col. William Arthur Woodside, Royal Army Medical Corps.

AWARDED THE MILITARY CROSS.

Capt. Frederick Jasper Anderson, M.B., Indian Medical Service.
Capt. Lionel Danyers Bailey, Royal Army Medical Corps.
Capt. Charles Henry Neil Baker, Indian Medical Service.
Capt. Walter Bisset, M.B., Royal Army Medical Corps.
Temp. Capt. Arthur Budd, M.B., Royal Army Medical Corps.
Capt Hari Chand, Indian Medical Service.
Temp. Capt. Alfred John Ireland, M.B., Royal Army Medical Corps.
Capt. James Melvin, M.B.. Royal Army Medical Corps, Special Reserve.
Capt. Stephen Harold Middleton-West, M.B.. Indian Medical Service.
Capt. Carl Henry Reinhold, F.R.C.S., Indian Medical Service.
Capt. Edward Percival Allman Smith, M.B., Royal Army Medical Corps.
Capt. Narendre Singh Sodhi, Indian Medical Service.
Temp. Capt. Donald McDonald Wilson, M.B., Royal Army Medical Corps.

War Office,
August 29, 1917.

His Majesty the King has been graciously pleased to approve of the undermentioned rewards for gallantry and distinguished service in the Field in Mesopotamia :—

AWARDED DISTINGUISHED CONDUCT MEDAL.

No. 32329 Cpl. (Acting Serjt.) O. Hatton, Royal Army Medical Corps.
For gallant and meritorious service throughout the operations. He has done consistent good work, and shown an utter disregard for danger, especially at the forcing of the passage of the river.

No. 26343 Pte. E. Mills, Royal Army Medical Corps.
For marked gallantry and devotion to duty. When the battery came under heavy fire he, regardless of danger, attended to the many wounded and also those of the infantry close by.

No. 35873 Serjt. S. Seager, Royal Army Medical Corps.
For gallantry and coolness under fire. When the stretcher-bearers were caught under a heavy fire he ably assisted them in taking cover, and eventually brought them back with only a few casualties.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officer :—

No. 305011 Serjt. R. Norrie, Royal Army Medical Corps (formerly 867). (Military Medal gazetted January 22, 1917.)

His Majesty the King has been graciously pleased to award the Military Medal for bravery in the Field to the undermentioned Non-commissioned Officer :—

No. 36449 Serjt. A. H. Cutts, Royal Army Medical Corps.

Awarded the Meritorious Service Medal for valuable services rendered with the Armies in the Field in Mesopotamia :—

No. 9481 Pte. (Acting Cpl.) J. A. Biggs, Royal Army Medical Corps.
No. 97903 Pte. A. Chapman, Royal Army Medical Corps (formerly No. 8137 South Lancashire Regiment).
No. 18912 Serjt -Major H. Dawson, Royal Army Medical Corps.
No. 28919 Serjt.-Major T. J. Evans, Royal Army Medical Corps.
No. 14210 Staff Serjt. J. Fulton, Royal Army Medical Corps.
No. 8520 Serjt. F. J. L. Godden, Royal Army Medical Corps.
No. 465121 Pte. C. R. Keeble, Royal Army Medical Corps.
No. 19489 Pte. T. Shelley, Royal Army Medical Corps.
No. 18170 Staff-Serjt. L. Sufrin, Royal Army Medical Corps.

War Office,
August 31, 1917.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS AND MEDALS CONFERRED BY HIS MAJESTY THE KING OF ITALY.

Bronze Medal for Military Valour.

No. 40210 Cpl. (Acting Serjt.) William Henry Selley, Royal Army Medical Corps.
No. 1804 (now 366118) Lance-Cpl. Thomas Jones, Royal Army Medical Corps.
No. 51611 Serjt. (Acting Serjt.-Major) Frank Milner, Royal Army Medical Corps.

Silver Medal for Military Valour.

Capt. Charles Aubrey Godson, Indian Medical Service.

Bronze Medal for Military Valour.

No. 242 Serjt.-Major William Henry Timke, South African Medical Corps.

War Office,
August 31, 1917.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS AND MEDALS PRESENTED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

LEGION D'HONNEUR.

Croix de Chevelier.

Major (Temp. Lieut.-Col.) Arthur Brownfield Fry, Indian Medical Service.

Croix de Guerre.

Capt. Lionel Douglas Bailey, Royal Army Medical Corps.
Temp. Lieut. Ratenshaw Nariman Kapadia, M.B., Indian Medical Service.
Capt. Alexander William Forrester, Medical Officer, Rhodesian Native Regiment.
Capt. Frederick William Hay, M.B., Indian Medical Service.
Capt. James Burne Lapsley, M.B., F.R.C.S., Indian Medical Service.

Medaille Militaire.

No. 405 Staff Serjt. George Henry Leather, South African Medical Corps.
No. 75188 Pte. James Ward Stanworth, Royal Army Medical Corps.

War Office,
September 6, 1917.

His Majesty the King has been graciously pleased to approve of the award of the Victoria Cross to the undermentioned Officer :—

Temp. Capt. Harold Ackroyd, M.C., M.D., late Royal Army Medical Corps (attached Royal Berkshire Regiment).

For most conspicuous bravery. During recent operations, Captain Ackroyd displayed the greatest gallantry and devotion to duty. Utterly regardless of danger, he worked continuously for many hours up and down in front of the line tending the wounded and saving the lives of Officers and men. In so doing he had to move across the open under heavy machine gun, rifle and shell fire. He carried a wounded officer to a place of safety under very heavy fire. On another occasion he went some way in front of our advanced line and brought in a wounded man under continuous sniping and machine gun fire.

His heroism was the means of saving many lives, and provided a magnificent example of courage, cheerfulness, and determination to the fighting men in whose midst he was carrying out his splendid work.

This gallant officer has since been killed in action.

War Office,
September 14, 1917.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Victoria Cross to Capt. Noel Godfrey Chavasse, V.C., M.C., late Royal Army Medical Corps, attached to the Liverpool Regiment.

For most conspicuous bravery and devotion to duty when in action.

Though severely wounded early in the action whilst carrying a wounded soldier to the dressing station, Capt. Chavasse refused to leave his post, and for two days not only continued to perform his duties, but, in addition, went out repeatedly under heavy fire to search for and attend to the wounded who were lying out.

During these searches, although practically without food during this period, worn with fatigue and faint with his wound, he assisted to carry in a number of badly wounded men, over heavy and difficult ground.

By his extraordinary energy and inspiring example, he was instrumental in rescuing many wounded who would otherwise have undoubtedly succumbed under the bad weather conditions.

This devoted and gallant officer subsequently died of his wounds.

War Office,
September 17, 1917.

His Majesty the King has been graciously pleased to approve of the appointments of the undermentioned Officers to be Companions of the Distinguished Service Order, in recognition of their gallantry and devotion to duty in the Field :—

Temp. Capt. Lewis Anderson, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He carried out his duties for forty-eight hours without relief, attending to over 100 cases, and working under the most adverse conditions. He was exposed throughout to intense and heavy fire of shell and gas shells, which rendered it necessary for him to work in a mask. The following night, after his battalion had been withdrawn, he returned to search for wounded in the front line, which was still in close contact with the enemy, and, after working for several hours under heavy shell fire, he collected and evacuated all his wounded, having displayed magnificent devotion and the utmost contempt for danger throughout.

Capt. (Temp. Lieut.-Col.) Norman Cecil Rutherford, M.B., F.R.C.S., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when in charge of an advanced dressing station. He worked continuously under heavy shell fire, evacuating the wounded from the forward area, and it was owing to his splendid example of devotion that the work was efficiently carried out.

His Majesty the King has been graciously pleased to confer the Military Cross on the undermentioned Officers and Warrant Officer in recognition of their gallantry and devotion to duty in the Field :—

Capt. John Arthur Bell, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty during a heavy bombardment. He proceeded along a road which was exposed to the most intense shell fire, in order to attend to four wounded officers. He dressed their wounds, and remained with them until they were evacuated by motor ambulance, which was only accomplished with the greatest difficulty, owing to the heavy shelling. His absolute disregard of danger and devotion to duty amidst terrific shell fire were exceptionally splendid, and beyond all praise.

Capt. John Bernard Cavenagh, M.B., Royal Army Medical Corps, Special Reserve.

For conspicuous gallantry and devotion to duty when in charge of bearers. He exposed himself to shell fire for forty-eight hours with splendid fearlessness, keeping all the time in touch with aid posts in the captured lines, thereby ensuring a rapid evacuation of the wounded.

Capt. Clarence Hamul Denyer, Royal Army Medical Corps,

For conspicuous gallantry and devotion to duty when in command of divisional bearers. It was due to his fearless and capable handling of his party that the evacuation of the wounded was carried out with rapidity and success.

Temp. Capt. Charles Dickson, M.D., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in charge of an advanced dressing station. Under an intense high explosive and gas-shell bombardment the building was partially wrecked, and the patients were in danger of death from gas poisoning. He at once personally organized a working party to replace the anti-gas screens and take other precautions for the safety of the wounded; this necessitated working in the open under extremely heavy fire, during which his total disregard of safety set a most inspiring example to his men. By his energy and devotion the lives of many badly wounded men were saved.

Temp. Capt. Charles Dundee, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. He worked for three days, bandaging the wounded under fire, and successfully evacuating every case in his battalion almost as soon as they occurred. Over five hundred cases passed through his hands, and he displayed a splendid spirit of energy and devotion.

Temp. Lieut. David Hammond Fraser, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. Whilst his battery was under very heavy gas bombardment a shell wrecked the officers' mess dug-out and buried two officers and five men. Lieut. Fraser, helped by a corporal, most gallantly assisted to rescue the buried men and restore respiration, entering the dug-out several times, until he eventually collapsed from the gas. On recovering consciousness he again attempted to enter the dug-out, but was prevented from doing so. Later, he collapsed again and remained unconscious for a long time. It was due to his promptness and energy that no more than two of the gassed men succumbed.

Temp. Capt. Augustus Joseph Hickey, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty when in command of an advanced dressing station. He worked with the utmost energy and disregard of danger for forty-eight hours under shell fire, during which time he passed through more than 700 wounded. His skill and devotion saved many lives.

Temp. Capt. William Bird Loveless, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in tending the wounded under heavy shell fire. Although wounded in the face early in the day, he did not leave his post, but continued with his work until he came out of action with his battalion, displaying splendid keenness and devotion to duty.

Temp. Capt. Anthony John McCreadie, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty under heavy shell fire and in most trying circumstances. He worked alone and incessantly for thirty-six hours in the open attending to the wounded, and on two occasions he carried men under cover and dressed them. He evacuated all the wounded with admirable rapidity and efficiency, and his coolness and disregard for personal safety under fire afforded a magnificent example to all ranks. He had displayed similar gallantry on other occasions.

Capt. John Morrison Milne, Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty. When a dug-out containing combustion products was blown in and the inmates buried he procured oxygen cylinders and played them into the dug-out, thereby saving their lives. He also assisted most untiringly in digging out the men, who owed their lives to his promptness and gallantry under heavy shell fire.

Temp. Capt. Samuel Ernest Picken, M.B., Royal Army Medical Corps.
For conspicuous gallantry and devotion to duty in going forward under heavy shell fire and attending to the wounded in advanced trenches and shell holes. He remained in the shelled area for a long period, working incessantly and efficiently at the dressing and evacuation of the wounded. He has always shown the same gallant spirit and devotion to duty.

Capt. James Calvert Spence, M.B., Royal Army Medical Corps Special Reserve.
For conspicuous gallantry and devotion to duty in proceeding to a battery that was suffering heavily from intense enemy shell fire, and continuing to search blown-in dug-outs and tend the wounded under heavy fire. He displayed exceptional coolness and gallantry on this occasion, and on many previous occasions he has carried out his duties with magnificent devotion.

Temp. Capt. Hugh Frederic Wickens, M.B., Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty in attending to the wounded whilst the camp was being heavily shelled. The dressing station was totally unprotected, and when it was eventually destroyed by enemy shell fire he showed splendid initiative and coolness in re-establishing his station elsewhere, continuing to clear the wounded and do his work in the most gallant and devoted manner. He has on several previous occasions displayed conduct of the same high order.

No. 36551 Serjt.-Major Leonard James Richardson, Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He proceeded from the main dressing station to a dump which was burning and exploding heavily, and set to work to remove and attend to the wounded, of whom he rescued at least twelve. Whilst thus engaged he was continually exposed to the most grave risk from exploding ammunition, flying débris and enemy shell fire, and was at one moment knocked over and severely shaken by an explosion near by. He continued, however, to work with magnificent energy and devotion, not withdrawing until satisfied that all the wounded had been evacuated.

CANADIAN FORCE.

Capt. John Ernest Affleck, Army Medical Corps.

For conspicuous gallantry and devotion to duty. He crawled along a shallow and much exposed trench to rescue a very severely wounded officer, whose life depended upon an immediate operation. With the assistance of a stretcher-bearer he managed to get the wounded man out on a blanket to a place where he could be evacuated. The task was a very slow and dangerous one, by reason of their being completely exposed to enemy snipers, but Capt. Affleck did not hesitate to risk his life to do all that was humanly possible for this wounded officer.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-Commissioned Officers for acts of gallantry and devotion to duty in the Field:—

No. 18566 Serjt. H. Butler (Ash Vale), Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty. He worked continuously for thirty-six hours under heavy shell fire, and it was largely due to his daring, coolness, and splendid leading that the battlefield was so rapidly cleared of wounded.

No. 341033 Acting Lance-Cpl. T. Pinkney (Vickerstown, Walney), Royal Army Medical Corps.

For conspicuous gallantry and devotion to duty when engaged in loading wounded on a motor ambulance. Coming under heavy shell fire he continued to attend to the wounded with great gallantry and coolness, although twice men were killed beside him and the driver of the car was wounded. The car was also damaged, but he procured assistance in loading it up and then drove it himself under heavy fire to the main dressing station, though his experience of driving cars was very slight. His conduct was magnificent throughout.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-Commissioned Officer:—

No. 405160 Serjt. H. E. Crofts, Royal Army Medical Corps (formerly 238), Sheffield. (M.M. gazetted December 14, 1916.)

His Majesty the King has been graciously pleased to award the Military Medal for Bravery in the Field to the undermentioned Non-Commissioned Officers and Men:—

No. 62606 Pte. J. Armstrong, Royal Army Medical Corps (St. Helens).
No. 461455 Pte. P. J. Aslatt, Royal Army Medical Corps (Southampton).
No. 61566 Lance-Serjt. J. H. Baker, Royal Army Medical Corps (Crewe).
No. 405120 Cpl. G. W. Ballard, Royal Army Medical Corps (Pittsmoor).
No. 54976 Cpl. (Acting Serjt.) R. K. Bathgate, Royal Army Medical Corps (Leith).
No. 461108 Serjt. E. E. F. Bolt, Royal Army Medical Corps (Southsea).
No. 341603 Pte. W. Coombes, Royal Army Medical Corps (St. Helens).
No. 24493 Pte. S. Dakin, Royal Army Medical Corps (Mansfield).
No. 538067 Pte. F. R. Dickson, Royal Army Medical Corps (Battersea).
No. 73928 Pte. J. Fraser, Royal Army Medical Corps (Dufftown).

No. 405195 Pte. B. Harvey, Royal Army Medical Corps (Attercliffe).
No. 36959 Serjt. (Acting Staff-Serjt.) A. C. Hill, Royal Army Medical Corps (Huntingdon).
No. 35040 Pte. W. L. Hislop, Royal Army Medical Corps (Edinburgh).
No. 538246 Pte. D. L. A. Hunt, Royal Army Medical Corps (S. Norwood).
No. 20794 Pte. (Acting-Cpl.) J. Hunt, Royal Army Medical Corps (Burnley).
No. 27363 Pte. L. A. S. Jones, Royal Army Medical Corps (Hastings).
No. 71981 Pte. J. F. McGowan, Royal Army Medical Corps (Rotherham).
No. 105338 Pte. F. J. Messenger, Royal Army Medical Corps (Hove).
No. 52433 Cpl. W. Mortimer, Royal Army Medical Corps (Leeds).
No. 345007 Cpl. (Acting Serjt.-Major) J. H. Nicholson, Royal Army Medical Corps (Scarborough).
No. 54545 Pte. J. J. O'Dwyer, Royal Army Medical Corps (Dublin).
No. 64378 Pte. J. Phillips, Royal Army Medical Corps (Edinburgh).
No. 405244 Serjt. F. Pickering, Royal Army Medical Corps (Sheffield).
No. 339321 Pte. E. Roberts, Royal Army Medical Corps (Liverpool).
No. 60915 Pte. A. Speirs, Royal Army Medical Corps (Glasgow).
No. 64611 Pte. C. Spencer, Royal Army Medical Corps (Wakefield).
No. 457407 Pte. G. N. Tanners, Royal Army Medical Corps (Chumleigh).
No. 59185 Pte. J. W. Traynor, Royal Army Medical Corps (Hebden Bridge).
No. 386145 Pte. H. Watson, Royal Army Medical Corps (Newcastle-on-Tyne).
No. 61981 Pte. W. Whitley, Royal Army Medical Corps (Dublin).
No. 69711 Pte. J. E. Williams, Royal Army Medical Corps (Brynteg).
No. 1559 Pte. (Acting Cpl.) W. H. Wyatt, Royal Army Medical Corps (Torquay).

His Majesty the King has been graciously pleased to award the Meritorious Service Medal to the undermentioned Men for gallantry in the performance of military duty:—
No. 36708 Pte. J. Brockless, Royal Army Medical Corps (Halifax).
No. 36717 Pte. E. Iredale, Royal Army Medical Corps (Halifax).
No. 36719 Pte. W. Jackson, Royal Army Medical Corps (Hebden Bridge).
No. 36729 Pte. J. Sidebottom, Royal Army Medical Corps (Halifax).

Military Medal Awards—Corrections.

Deletions.

London Gazette, dated July 9, 1917.

Delete No. 30504 Serjt. R. Norrie, Royal Army Medical Corps (M.M. gazetted January 22, 1917).

London Gazette, dated September 21, 1916.

Delete No. 987 Serjt. R. Fraser, Royal Army Medical Corps. (This non-commissioned officer was awarded the D.C.M., *London Gazette* dated October 20, 1916, in lieu of the Military Medal.)

War Office,
September 18, 1917.

The names of the undermentioned have been brought to the notice of the Secretary of State for War for valuable services rendered in connexion with the War:—

Medical Services.

Col. G. G. Adams.
Temp. Major T. S. Allan.
Temp. Qmr. and Hon. Lieut. T. Allen.
Major W. E. A. Armstrong, Indian Medical Service.
Major J. A. Anderson.
Major R. Y. Anderson, M.B.
Lieut.-Col. F. H. Appleby.
Capt. T. Armour.
Capt. W. G. Ball.
Temp. Lieut.-Col. G. A. Bannatyne.
Capt. A. S. Barnes.
Lieut.-Col. Sir J. Barr.
Qmr. and Hon. Major J. H. W. Beach.

Lieut.-Col. F. W. Begbie.
Lieut.-Col. R. Benson.
Major R. A. Bickersteth.
Surg.-Gen. W. G. Birrell.
Col. L. J. Blandford.
Temp. Capt. J. Bowes.
Capt. E. C. Bradford.
Qmr. and Hon. Major T. F. Brake (ret. pay).
Major C. Bramhall.
Lieut.-Col. H. Bramwell.
Major H. A. Bransbury.
Temp. Capt. C. W. J. Brasher.
Lieut.-Col. G. A. T. Bray.
Lieut.-Col. H. A. Bray, C.M.G.
Temp. Capt. R. H. Bremridge.
Capt. E. A. P. Brock.
Temp. Capt. F. W. Broderick.
Lieut.-Col. J. F. Brodie.
Qmr. and Hon. Capt. F. Bruce (ret. pay).
Temp. Major H. W. Bruce.
Lieut.-Col. H. E. Bruce-Porter.
Temp. Capt. R. Buchanan.
Lieut.-Col. G. H. Bull, Indian Medical Service (ret. pay).
Col. W. H. Bull.
Temp. Lieut.-Col. D. Buncombe.
Col. P. C. Burgess.
Temp. Capt. J. Burnford.
Col. E. Butt.
Temp. Lieut.-Col. J. B. Byles.
Col. R. Caldwell.
Capt. F. G. Caley.
Lieut.-Col. E. M. Callender.
Temp. Capt. W. K. Carew.
Temp. Lieut.-Col. A. Carless.
Temp. Capt. J. E. Carruthers.
Lieut.-Col. W. P. Carson, Indian Medical Service.
Temp. Lieut.-Col. A. H. Carter.
Lieut.-Col. C. W. Cathcart.
Hon. Temp. Lieut.-Col. H. Chaffer.
Major A. J. Chambers (ret. pay).
Temp. Capt. E. Chambers.
Lieut.-Col. J. Clayton-White, Indian Medical Service.
Col. Sir J. Clark, R.A.
Lieut.-Col. T. H. M. Clarke.
Lieut.-Col. T. H. F. Clarkson.
Lieut.-Col. G. J. Coates.
Col. W. Coates, C.B.
Lieut.-Col. M. A. T. Collie, Indian Medical Service.
Temp. Capt. A. Compton.
Col. B. B. Connolly, C.B. (ret. pay).
Temp. Lieut.-Col. H. G. Cook.
Lieut.-Col. M. P. Corkery.
Capt. E. M. Corner.
Temp. Capt. W. B. Cosens.
Lieut.-Col. R. Cottell.
Capt. L. Courtauld.
Lieut. T. Croft.
Col. A. E. J. Croly.
Lieut.-Col Sir W. R. Grook-Lawless.
Major H. A. Cummins.
Major E. N. Cunliffe.
Lieut.-Col. R. O. Cussack (ret. pay).
Col. J. H. Daly.

Temp. Major W. R. Dawson.
Capt. C. S. Deane.
Temp. Capt. S. E. Denyer.
Temp. Capt. J. R. Dickson.
Temp. Major C. B. Dobell.
Temp. Capt. E. L. Dobson.
Col. J. R. Dodd (ret. pay).
Temp. Lieut.-Col. A. P. Dodds-Parker.
Capt. G. H. Dominy.
Capt. J. S. C. Douglas.
Lieut.-Col. V. G. Drake-Brockman, Indian Medical Service.
Temp. Capt. J. D. Duncan.
Surg.-Gen. J. D. Edge, C.B.
Lieut.-Col. C. W. Edwards.
Lieut.-Col. F. W. Ellis.
Lieut.-Col. N. Faichnie.
Temp. Capt. N. M. Falkiner.
Major A. C. Farquharson.
Lieut.-Col. Sir J. Fayrer.
Temp. Capt. W. Fell.
Major E. G. Ffrench.
Capt. G. L. Findlay.
Temp. Capt. W. T. Finlayson.
Capt. N. S. Finzi.
Col. H. H. Forman.
Temp. Capt. A. A. Forty.
Temp. Lieut.-Col. T. H. Gibbon.
Qmr. and Hon. Lieut. T. Gibbs.
Capt. W. Gibbs-Lloyd.
Qmr. and Hon. Major J. Gillman.
Capt. E. E. Glynn.
Lieut.-Col. G. M. Goldsmith.
Temp. Lieut.-Col. E. Goodall.
Capt. G. W. Goodhart.
Surg.-Major J. F. Gordon Dill.
Major A. M. Gossage, M.B.
Capt. A. H. Gosse.
Major D. J. Graham.
Major E. Gray.
Major T. W. Griffith.
Temp. Capt. A. Griffiths.
Col. J. Griffiths.
Temp. Capt. W. Griffiths.
Surg.-Gen. Sir W. L. Gubbins, K.C.B., M.V.O.
Col. R. I. D. Hackett.
Temp. Major J. H. Hall-Edwards.
Lieut.-Col. R. H. Hall.
Temp. Qmr. and Hon. Lieut. A. E. Hanrahan.
Lieut.-Col. T. W. O'H. Hamilton.
Temp. Major L. C. V. Hardwicke.
Lieut.-Col. L. W. Harrison.
Major G. P. O. Hawker.
Capt. F. S. Hawks.
Qmr. and Hon. Capt. R. Hawkey (retired pay).
Qmr. and Hon. Lieut. C. Hayward.
Lieut.-Col. M. L. Hearn (retired pay).
Temp. Capt. J. P. Helliwell.
Major R. W. W. Henry.
Temp. Capt. S. L. Hinde.
Temp. Capt. A. C. Holden.
Major W. A. L. Holland.
Major C. H. Hopkins.
Capt. T. J. Horder.

Col. S. S. Hoyland.
Temp. Major D. W. Hume.
Temp. Major A. M. Humphrey.
Capt. F. H. Humphries.
Lieut.-Col. F. S. Irvine.
Temp. Capt. A. L. Jackson.
Lieut.-Col. C. James.
Hon. Surg.-Col. W. C. James.
Lieut.-Col. J. B. Jameson, I.M.S.
Temp. Capt. W. W. Jameson.
Major J. K. Jamieson.
Qmr. and Hon. Lieut. E. Janes.
Col. R. Jennings.
Qmr. and Hon. Major H. Johnson.
Lieut.-Col. P. H. Johnston.
Temp. Capt. I. Jones.
Capt. A. A. Jubb.
Temp. Lieut.-Col. J. Keay.
Temp. Qmr. and Hon. Lieut. C. R. W. Keefe.
Temp. Col. F. Kelly.
Temp. Capt. A. M. Kennedy.
Temp. Lieut.-Col. H. A. Kidd.
Major W. Kirkpatrick.
Temp. Capt. A. B. Laidlaw.
Temp. Capt. H. C. T. Langdon.
Temp. Major J. S. Law.
Temp. Major J. R. Lee.
Surg.-Gen. O. E. P. Lloyd, V.C., C.B., retired pay.
Qmr. and Hon. Major H. Lockhart.
Temp. Lieut.-Col. J.R. Lord.
Col. T. J. R. Lucas, C.B., retired pay
Temp. Capt. A. Lundie.
Lieut.-Col. A. A. Lyle, retired pay.
Major J. P. Lynch.
Surg.-Major F. F. MacCabe, special reserve.
Temp. Major D. K. MacDowell.
Major W. G. Macfee.
Temp. Major C. V. MacKay.
Lieut.-Col. A. W. MacKintosh.
Temp. Capt. P. W. Maclagan.
Temp. Capt. J. M. MacMillan.
Major J. N. Macmullan.
Temp. Major H. G. Magrath.
Lieut.-Col. J. R. Mallins.
Capt. W. Martin.
Temp. Major H. C. Marr.
Qmr. and Hon. Capt. J. Mathews.
Qmr. and Hon. Lieut. L. Matthews.
Col. W. A. May, C.B.
Temp. Capt. J. T. McCullagh.
Col. C. H. Melville.
Major A. A. W. Merrick.
Lieut.-Col. J. Mill.
Lieut.-Col. L. A. Mitchell.
Lieut.-Col. J. M. Moir.
Lieut.-Col. A. H. Morris.
Temp. Major J. S. Morrow.
Lieut.-Col. R. E. R. Morse.
Temp. Lieut.-Col. S. Mort.
Temp. Capt. L. W. Mortimer.
Major F. W. Mott.
Lieut.-Col. C. W. M. Moullin.
Major A. Mowat.

Temp. Lieut.-Col. Sir B. G. A. Moynihan, C.B.
Temp. Capt. G. Muir.
Capt. H. L. Munro.
Temp. Capt. C. E. Murphy.
Lieut.-Col. Sir S. F. Murphy.
Temp. Major E. H. T. Nash.
Col. L. T. M. Nash.
Temp. Major A. Neve.
Col. F. P. Nichol.
Temp. Major C. Noon.
Temp. Qmr. and Hon. Lieut. J. Ogden.
Col. C. P. Oliver.
Temp. Capt. N. H. Oliver.
Temp. Capt. J. F. O'Malley.
Temp. Major L. Owen.
Lieut.-Col. H. K. Palmer.
Lieut.-Col. Sir A. Pearce-Gould.
Temp. Capt. R. E. F. M. Pearse.
Temp. Capt. J. H. Peek.
Capt. C. E. Petley.
Temp. Capt. A. Phillips.
Lieut.-Col. E. V. A. Phipps.
Temp. Lieut. A. C. Pickett.
Bt.-Col. E. M. Pilcher.
Qmr. and Hon. Capt. A. J. Pilgrim.
Capt. H. Pinto-Leite.
Lieut.-Col. D'A. Power, M.B.
Temp. Lieut.-Col. W. T. Prout.
Temp. Major F. C. Purser.
Col. W. J. R. Rainsford, retired pay.
Capt. C. F. Read.
Lieut.-Col. W. L. Reade.
Lieut.-Col. E. S. Reynolds.
Temp. Major T. B. Rhodes.
Temp. Major R. G. Riches.
Lieut.-Col. B. Riddell.
Temp. Major N. Roberts.
Temp. Major F. M. Rodgers.
Major R. C. Rodgers.
Hon. Surg.-Col. W. M. Roocroft.
Capt. C. H. Rook, Special Reserve.
Temp. Lieut.-Col. F. Romer.
Qmr. and Hon. Lieut. H. H. Ross.
Temp. Capt. J. R. H. Ross.
Lieut.-Col. C. F. Routh.
Lieut.-Col. W. Rowney, retired pay.
Temp. Major R. G. Rows.
Col. A. F. Russell, retired pay.
Major G. B. Russell.
Lieut.-Col. J. V. Salvage.
Temp. Capt. C. Samut.
Temp. Capt. W. Sansom.
Temp. Major W. Scatterty.
Capt. H. A. Scholberg.
Capt. H. R. Sedgwick.
Temp. Major G. T. S. Sichel.
Temp. Lieut.-Col. A. Simpson.
Temp. Major G. Simpson.
Major M. S. Skirving, Australian Army Medical Corps.
Col. H. M. Sloggett.
Lieut.-Col. P. C. Smith.
Hon. Surg.-Gen. W. R. Smith.
Lieut.-Col. W. F. Somerville.

Major C. G. Spencer (retired pay).
Major G. H. Spencer.
Temp. Capt. W. S. Sprent.
Temp. Capt. W. S. Stalker.
Major H. K. Steele (Special Reserve).
Temp. Capt. L. H. Y. Stephen.
Surg.-Gen. W. F. Stevenson, C.B.
Temp. Capt. C. R. Stewart.
Temp. Major H. J. Stiles.
Major W. S. V. Stock.
Temp. Capt. A. Stodart-Walker.
Temp. Capt. F. W. S. Stone.
Qmr. and Hon. Lieut. S. Sully.
Temp. Capt. R. W. Sutherland.
Lieut.-Col. M. Swaby.
Temp. Capt. B. Sweeten.
Major J. Tait.
Temp. Major J. G. Taylor.
Temp. Lieut.-Col. W. Taylor.
Temp. Lieut. D. G. Thomson.
Lieut.-Col. H. Thomson, Indian Medical Service.
Lieut.-Col. S. J. Thomson, Indian Medical Service.
Surg.-Col. A. Thorne.
Lieut.-Col. E. N. Thornton, South African Medical Corps.
Lieut.-Col. J. Tidbury.
Major H. W. M. Tims.
Major W. E. F. Tinley.
Qmr. and Hon. Lieut. A. G. Tod.
Col. O. Todd.
Temp. Qmr. and Hon. Lieut. J. Tonkinson.
Temp. Major F. S. Toogood.
Lieut. Col. T. B. A. Tuckey (retired pay).
Temp. Lieut.-Col. W. J. N. Vincent.
Major C. W. Vining.
Capt. S. G. Vintner.
Major D. Walker.
Temp. Capt. R. R. Wallace.
Col. C. A. Webb.
Major S. G. Webb.
Capt. F. J. Wethered.
Temp. Hon. Major W. I. de C. Wheeler.
Surg. Lieut.-Col. P. H. Whiston.
Qmr. and Hon. Capt. J. C. B. Whitehorn.
Lieut.-Col. C. W. H. Whitestone.
Temp. Qmr. and Hon. Lieut. L. Whittaker.
Qmr. and Hon. Lieut. F. B. Wild.
Temp. Capt. G. C W. Williams.
Lieut.-Col. S. R. Wills.
Lieut.-Col. A. R. Wilson.
Capt. J. A. L. Wilson (Special Reserve).
Temp. Lieut.-Col. T. B. Winter.
Temp. Capt. E. W. Witham.
Temp. Qmr. and Hon. Lieut. J. H. Withy.
Temp. Major J. C. Woods.
Temp. Lieut.-Col. J. F. Woodyatt.
Qmr. and Hon. Major H. Woolley.
Temp. Major R. Worth.
Temp. Lieut.-Col. W. Wrangham.
Temp. Lieut.- Col. G. A. Wright.
Major W. E. Wynter.
Major A. G. Yates.
Temp. Major C. S. Young.
Lieut.-Col. G. H. Younge (retired pay).

War Office,
September 22, 1917.

MENTIONS IN DISPATCHES.

Mesopotamia.

The following names are added to the list of Officers, Warrant and Non-commissioned Officers and Men, ladies and civilians whose services have been brought to notice as deserving of special mention by Lieut.-General Sir Stanley Maude, K.C.B., Commander-in-Chief, Mesopotamian Expeditionary Force, in his Dispatch (published in the *London Gazette*, No. 30233, dated August 15, 1917) :—

Temp. Qmr. and Hon. Lieut. A. R. Rees, Royal Army Medical Corps.

No. 8962 Qmr.-Serjt. A. J. Canty, Royal Army Medical Corps.

CORRIGENDA TO "MENTIONS IN DISPATCHES."

British Armies in France Dispatches.

Supplement to the *London Gazette*, dated May 28, 1917 (No. 30101) under Royal Army Medical Corps (page 5321)—*For* Temp. Qmr. and Hon. Lieut. A. Morrison, *read* Qmr. and Hon. Capt. A. Morrison.

Supplement to the *London Gazette*, dated June 1, 1917 (No. 30107). Under Canadian Army Medical Corps (page 5428). *After* Lieut. (Temp. Capt.) A. F. Laird, M.D., *insert* Royal Army Medical Corps.

Salonika Dispatches.

Supplement to the *London Gazette*, dated July 21, 1917 (No. 30196). Under Royal Army Medical Corps (page 7455) *for* No. 57440 Pte. P. C. Allen, *read* No. 57440 Pte. C. Allen.

Mesopotamia Dispatches.

Supplement to the *London Gazette*, dated August 15, 1917 (No. 30233). Under Royal Army Medical Corps (page 8336). *For* No. 97873 Pte. E. Haywood, *read* No. 97873 Pte. E. Hayward.

War Office,
September 24, 1917.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign :—

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS CONFERRED BY HIS MAJESTY THE KING OF THE BELGIANS.

Ordre de Leopold.

Officier : Lieut.-Col. (Temp. Col.) John Donald Alexander, D.S.O., M.B., Royal Army Medical Corps.

Chevaliers : Capt. Thomas Frederick Corkill, M.C., Royal Army Medical Corps (Special Reserve) ; Temp. Capt. John Henry Herbert Pearson, M.D., Royal Army Medical Corps.

Ordre de la Couronne.

Grand Officier : Surg.-Gen. Sir Alfred Keogh, G.C.B., M.D., F.R.C.P., Director-General, Army Medical Service.

Commandeur : Surg.-Gen. Sir William Donovan, K.C.B., Maritime Transport ; Surg.-Gen. Sir Tom Percy Woodhouse, K.C.M.G., C.B., Director of Medical Department, Shipping Line.

Officier : Lieut.-Col. (Temp. Col.) Harold Percy Waller Barrow, C.M.G., Deputy Assistant Director-General, Army Medical Service ; Col. James Barnett Wilson, C.M.G., M.D.

War Office,
September 25, 1917.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign.

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS AND MEDALS PRESENTED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

Légion d'Honneur.

Grand Officier: Surg.-Gen. Sir Alfred Keogh, G.C.B., M.D., F.R.C.P., retired pay.

Croix de Guerre.

No. 5846 Pte. William Brownlie. Royal Army Medical Corps (Coatbridge).

War Office,
September 17, 1917.

His Majesty the King has been graciously pleased to approve of the undermentioned rewards for distinguished service in the Field:—

TO BE BREVET LIEUTENANT-COLONEL.

Major (Temp. Lieut.-Col.) R. M. Carter, F.R.C.S., Indian Medical Service (with effect from April 26, 1916, inclusive).

TO BE COMPANIONS OF THE DISTINGUISHED SERVICE ORDER.

Major Robert Archer Lloyd, M.D., Indian Medical Service.
Lieut. (Temp. Capt.) Arthur Frederick Isbell Patterson, Royal Army Medical Corps.

War Office,
September 26, 1917.

His Majesty the King has been pleased to confer the undermentioned rewards for gallantry and distinguished service in the Field:—

The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable.

AWARDED A BAR TO THE DISTINGUISHED SERVICE ORDER.

Major James Samuel Yeaman Rogers, D.S.O., Royal Army Medical Corps (D.S.O. gazetted January 14, 1916).

AWARDED THE DISTINGUISHED SERVICE ORDER.

Capt. (Acting Lieut.-Col.) John Darling Bowie, Royal Army Medical Corps.
Temp. Capt. Ivan Clarkson Maclean, M.C., Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) Edwin Charles Montgomery-Smith, Royal Army Medical Corps.
Temp. Capt. John Boyd Orr, M.C., M.B., Royal Army Medical Corps.
Temp. Capt. Hubert Arnold Pallant, M.C., Royal Army Medical Corps.
Capt. Gwelym David Watkins, Royal Army Medical Corps.

AWARDED A BAR TO THE MILITARY CROSS.

Capt. William Barnsley Allen, V.C., M.C., Royal Army Medical Corps (M.C. gazetted September 26, 1916).
Temp. Lieut. (Temp. Capt.) Lancelot Gerard Bourdillon, D.S.O., M.C., Royal Army Medical Corps (M.C. gazetted January 14, 1916).
Temp. Capt. Robert Inkerman Harris, M.C., Royal Army Medical Corps (M.C. gazetted November 14, 1916).
Capt. Wilfred McFarlane, M.C., M.B., Royal Army Medical Corps (M.C. gazetted December 11, 1916).
Capt. Hugh Roger Partridge, M.C., Royal Army Medical Corps (M.C. gazetted October 20, 1916).
Capt. John Dover Proud, M.C., Royal Army Medical Corps (Special Reserve), (M.C. gazetted June 18, 1917).

AWARDED THE MILITARY CROSS.

Temp. Capt. George Min Adam, M.B., Royal Army Medical Corps.
Capt. Cuthbert Delaval Shafto Agassiz, M.B., Royal Army Medical Corps.
Capt. Arthur Cyril Bateman. Royal Army Medical Corps (Special Reserve).
Temp. Capt. Stanley James Annear Beale, M.B., Royal Army Medical Corps.
Capt. Kenneth Biggs, Royal Army Medical Corps (Special Reserve).

Temp. Capt. Geoffrey Andrew Bird, M.B., Royal Army Medical Corps.
Capt. Ribton Gore Blair, M.B., Royal Army Medical Corps (Special Reserve).
Capt. Francis Dawson Blandy, M.D., Royal Army Medical Corps.
Temp. Capt. Clarence Albert Briscoe, Royal Army Medical Corps.
Temp. Capt. William Thomson Brown, M.B., Royal Army Medical Corps.
Temp. Capt. Wilfrid Thomas Chaning Pearce, Royal Army Medical Corps.
Temp. Capt. Francis Bernard Chavasse, Royal Army Medical Corps.
Temp. Capt. Victor Lindle Connolly, Royal Army Medical Corps.
Capt. Thomas Frederick Corkhill, Royal Army Medical Corps (Special Reserve).
Temp. Capt. George Theodore Cregan, M.B., Royal Army Medical Corps.
Temp. Capt. Douglas St. Clair Creighton, M.D., Royal Army Medical Corps.
Temp. Capt. Eric Payten Dark, M.B., Royal Army Medical Corps.
Temp. Capt. Harold Benjamin Day, Royal Army Medical Corps.
Temp. Capt. James Walker Dorling, M.B., Royal Army Medical Corps.
Capt. William Ernest Fitzgerald, M.B., Royal Army Medical Corps.
Temp. Capt. Robert Stuart Gibson, M.B., Royal Army Medical Corps.
Temp. Capt. John Charles Boileau Grant, M.B., Royal Army Medical Corps.
Temp. Captain Norman Grellier, Royal Army Medical Corps.
Temp. Capt. Frederick Harris, Royal Army Medical Corps.
Temp. Lieut. Gerald Woodforde Harrison, Royal Army Medical Corps.
Temp. Capt. Howard Havelock Hepburn, Royal Army Medical Corps.
Temp. Capt. James Hill, M.B., Royal Army Medical Corps.
Temp. Lieut. Reginald Gordon Hill, M.B., Royal Army Medical Corps.
Temp. Lieut. William Johnstone Isbister, Royal Army Medical Corps.
Temp. Lieut. Ronald Sinclaire Kennedy, Royal Army Medical Corps, South Lancashire Regiment.
Temp. Capt. Archibald Forbes Laird, Royal Army Medical Corps.
Temp. Capt. George Edwin Lindsay, M.B., Royal Army Medical Corps.
Temp. Capt. Clement Richard MacLeod, Royal Army Medical Corps.
Temp. Capt. Daniel McVicker, Royal Army Medical Corps.
Temp. Capt. Jerome Ivo O'Sullivan, Royal Army Medical Corps.
Temp. Capt. William Hilton Parry, M.B., Royal Army Medical Corps.
Capt. James Alexander Paterson, M.B., Royal Army Medical Corps.
Temp. Capt. Frederick Tavinor Rees, Royal Army Medical Corps.
Temp. Capt. Douglas Swan Robertson, M.B., Royal Army Medical Corps.
Capt. Gilbert William Rogers, M.B., Royal Army Medical Corps.
Capt. James Ellis Rusby, Royal Army Medical Corps (Special Reserve).
Temp. Lieut. John Peter Ryan, Royal Army Medical Corps.
Temp. Capt. Alexander Hugh Dickson Smith, Royal Army Medical Corps.
Temp. Capt. James Anstruther Smith, M.B., Royal Army Medical Corps.
Capt. Herbert Mather Spoor, M.B., Royal Army Medical Corps.
Capt. Robert Alexander Stark, M.B., Royal Army Medical Corps.
Capt. John Stephenson, Royal Army Medical Corps (Special Reserve).
Capt. William Howard Edwin Stewart, Royal Army Medical Corps.
Temp. Capt. Thomas James Logan Thompson, M.B., Royal Army Medical Corps.
Temp. Capt. Edward Archibald Walker, M.D., Royal Army Medical Corps.
Temp. Lieut. Thomas Charles Dalrymple Watt, M.B., Royal Army Medical Corps.
Temp. Capt. Hubert Francis Wilson, M.B., Royal Army Medical Corps.
No. 34124 Serjt.-Major Alfred Percy Hatt, Royal Army Medical Corps.

Australian Imperial Force.

Capt. John Canute Gordon Glassford, Army Medical Corps.

New Zealand Force.

Capt. Herbert Myer Goldstein, Medical Corps.

The following are among the Decorations and Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign.

His Majesty the King has given unrestricted permission in all cases to wear the Decorations and Medals in question.

DECORATIONS AND MEDALS PRESENTED BY THE PRESIDENT OF THE FRENCH REPUBLIC.

LEGION D'HONNEUR.

Croix de Guerre.

Major (Temp. Lieut.-Col.) Leonard Joseph Montagu Deas, M.B., F.R.C.S., Indian Medical Service.

Temp. Capt. Archibald Louis George, Royal Army Medical Corps.

No. 15289 Serjt. (Acting Staff-Serjt.) Harry Rowland Martin Rodman, Royal Army Medical Corps (Upminster).

War Office,
September 28, 1917.

His Majesty the King has been graciously pleased to approve of the award of a Second Bar to the Military Medal to the undermentioned Man:—

No. 63085 Pte. H. Brooker, Royal Army Medical Corps (Rochdale). (M.M. gazetted January 6, 1917.) (First Bar gazetted August 16, 1917.)

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officers:—

No. 67052 Serjt. R. Holt, Royal Army Medical Corps (Liverpool). (M.M. gazetted January 6, 1917.)

No. 67028 Serjt. W. Ogden, Royal Army Medical Corps (Swinton). (M.M. gazetted June 18, 1917.)

His Majesty the King has been graciously pleased to award the Military Medal for bravery in the Field to the undermentioned Non-commissioned Officers and Men:—

No. 60449 Pte. W. Absolom, Royal Army Medical Corps (Blaenavon).
No. 401325 Pte. H. V. Adams, Royal Army Medical Corps (Doncaster).
No. 303026 Pte. W. Allan, Royal Army Medical Corps (Aberdeen).
No. 401452 Serjt. E. Beevers, Royal Army Medical Corps (Leeds).
No. 49066 Lance-Cpl. D. Bennett, Royal Army Medical Corps (Houghton-le-Spring).
No. 62185 Pte. A. Booth, Royal Army Medical Corps (Batley).
No. 8143 Pte. O. Boylan, Royal Army Medical Corps (Denaby).
No. 405114 Pte. H. Bradshaw, Royal Army Medical Corps (Sheffield).
No. 400051 Pte. C. Broadbent, Royal Army Medical Corps (Halifax).
No. 457291 Pte. W. J. Burnett, Royal Army Medical Corps (Penzance).
No. 457013 Serjt. R. Coleridge, Royal Army Medical Corps (Teignmouth).
No. 81090 Pte. F. Clare, Royal Army Medical Corps (Nottingham).
No. 40468 Pte. (Acting Serjt.) W. Crabtree, Royal Army Medical Corps (Norden).
No. 74780 Pte. A. F. Creighton, Royal Army Medical Corps (Broadchalk, Wilts.).
No. 459018 Cpl. G. Crocker, Royal Army Medical Corps (Plymouth).
No. 7285 Pte. W. Crossley, Royal Army Medical Corps (Cwm).
No. 44356 Pte. J. H. Culligan, Royal Army Medical Corps (Egremont).
No. 48721 Pte. R. S. Cunningham, Royal Army Medical Corps (Ashton-under-Lyne).
No. 48329 Serjt. H. H. Dando, Royal Army Medical Corps (Abertillery).
No. 50169 Pte. H. Dixon, Royal Army Medical Corps (Darton).
No. 48656 Pte. J. P. Dudds, Royal Army Medical Corps (Cefnybedd).
No. 65309 Pte. B. Edwards, Royal Army Medical Corps (Brighton).
No. 534050 Acting Lance-Cpl. F. J. Gold, Royal Army Medical Corps (Dartford).
No. 53437 Serjt. J. Graham, Royal Army Medical Corps (Biggar).
No. 488 Pte. A. Haddow, Royal Army Medical Corps (Glasgow).
No. 38166 Pte. W. B. Halley, Royal Army Medical Corps (Kirkcaldy).
No. 67025 Pte. J. E. Hargreaves, Royal Army Medical Corps (Clitheroe).
No. 67107 Pte. J. Hollingworth, Royal Army Medical Corps (Ashton-under-Lyne).
No. 405079 Pte. L. Hoyland, Royal Army Medical Corps (Sheffield).
No. 401205 Lance-Cpl. J. W. Ibbetson, Royal Army Medical Corps (Leeds).
No. 401436 Pte. H. Johnson, Royal Army Medical Corps (Leeds).
No. 23224 Pte. G. A. L. Johnston, Royal Army Medical Corps (Newcastle-on-Tyne).
No. 401234 Lance-Serjt. A. Kew, Royal Army Medical Corps (Pudsey).
No. 70744 Pte. F. W. King, Royal Army Medical Corps (West Ham).
No. 461531 Pte. F. P. Lanham, Royal Army Medical Corps (Southampton).

No. 339229 Pte. A. E. Lewin, Royal Army Medical Corps (Liverpool).
No. 67349 Pte. (Acting Lance-Cpl.) P. Margrave, Royal Army Medical Corps (Droylesdon).
No. 461047 Pte. A. F. Mason, Royal Army Medical Corps (Southampton).
No. 47996 Pte. E. J. McArdle, Royal Army Medical Corps (Liverpool).
No. 88387 Pte. K. McCreadie, Royal Army Medical Corps (Dunoon).
No. 339344 Pte. (Acting Lance-Cpl.) W. McMillin, Royal Army Medical Corps (Egremont).
No. 49477 Pte. F. McNaughton, Royal Army Medical Corps (Glasgow).
No. 83044 Pte. W. Megicks, Royal Army Medical Corps (Lampeter).
No. 44713 Pte. T. Miller, Royal Army Medical Corps (Oughtibridge).
No. 66755 Pte. W. A. Newman, Royal Army Medical Corps (King's Heath).
No. 339081 Pte. J. O'Connor, Royal Army Medical Corps (Liverpool).
No. 39399 Pte. W. Pagett, Royal Army Medical Corps (Sparkbrook).
No. 45172 Pte. (Acting Cpl.) A. Palmer, Royal Army Medical Corps (St. Helens).
No. 8898 Pte. D. Paterson, Royal Army Medical Corps (Leven).
No. 45474 Pte. H. Perry, Amb., Royal Army Medical Corps (Cheshunt).
No. 39589 Pte. F. Reid, Royal Army Medical Corps (Hatton Garden, E.C.).
No. 45176 Pte. E. Roberts, Royal Army Medical Corps (Cefn).
No. 40068 Serjt. (Acting Staff-Serjt.) J. H. Russ, Royal Army Medical Corps (Hoxton).
No. 7697 Pte. W. S. Samson, Royal Army Medical Corps (Binfield).
No. 48186 Lance-Cpl. D. J. Samuel, Royal Army Medical Corps (Ogmore Vale).
No. 106201 Pte. W. Sanderson, Royal Army Medical Corps (Loftus).
No. 457032 Pte. (Acting Cpl.) A. Sellick, Royal Army Medical Corps (Exeter).
No. 48458 Pte. W. Sharp, Royal Army Medical Corps (Llechryd).
No. 35589 Pte. H. H. Smalley, Royal Army Medical Corps (Oldham).
No. 74018 Pte. W. G. Smith, Royal Army Medical Corps (Shirley).
No. 66839 Pte. C. H. Stephens, Royal Army Medical Corps (Winckley).
No. 48192 Cpl. (Acting Serjt.) E. Sweeting, Royal Army Medical Corps (Newport, Mon.).
No. 38461 Serjt. (Acting Staff-Serjt.) J. Taylor, Royal Army Medical Corps (Wrexham).
No. 48036 Serjt. B. Thomas, Royal Army Medical Corps (Mountain Ash).
No. 50132 Pte. W. Thomas, Royal Army Medical Corps (Winson Green).
No. 48196 Lance-Cpl. W. G. Thomas, Royal Army Medical Corps (Penygroes).
No. 457250 Serjt. P. W. Tighe, Royal Army Medical Corps (Exeter).
No. 401194 Lance-Cpl. R. Vaughan, Royal Army Medical Corps (Leeds).
No. 74833 Pte. J. E. Waldron, Royal Army Medical Corps (Christow).
No. 83114 Pte. W. Walmsley, Royal Army Medical Corps (Rochdale).
No. 66829 Pte. P. W. Welch, Royal Army Medical Corps (High Wycombe).
No. 47292 Cpl. W. Whitlow, Royal Army Medical Corps (Chester).
No. 461173 Cpl. R. Witt, Royal Army Medical Corps (Southampton).

ROYAL ARMY MEDICAL CORPS.

Major Percy S. Lelean, C.B., F.R.C.S., relinquishes the rank of Temp. Lieut.-Col. on reposting, dated March 28, 1916.

The undermentioned relinquish the acting rank of Lieut.-Col. on reposting:—

Dated May 20, 1917.—Major Harry W. Russell, M.D.
Dated July 16, 1917.—Major George H. Richard.
Dated July 24, 1917.—Major Edward H. M. Moore.
Dated July 26, 1917.—Capt. Richard E. U. Newman, M.C., M.B.

The undermentioned to be Acting Lieut.-Cols. whilst in command of a Convalescent Depot:—

Dated July 3, 1917.—Major James H. Campbell, D.S.O., M.B.; Major Charles D. Myles, M.B.; Capt. Alfred C. Elliott, M.B.; Capt. Arthur F. Heaton, Reserve of Officers; Temp. Major Joseph Dalrymple.
Dated August 4, 1917.—Major Reginald V. Cowey, D.S.O.

The undermentioned to be Acting Lieut.-Cols. whilst in command of a Field Ambulance:—

Dated August 6, 1917.—Capt. Cecil Scaife, M.D.
Dated August 10, 1917.—Capt. Richard E. U. Newman, M.B.
Dated August 30, 1917.—Major Richard G. Meredith, M.B.

ROYAL ARMY MEDICAL COLLEGE.

LIST OF BOOKS ADDED TO THE LIBRARY DURING THE MONTHS OF JULY, AUGUST AND SEPTEMBER, 1917.

Title of Work and Author	Edition	Date	How obtained
Operative Surgery of the Nose, Throat and Ear. By H. W. Loeb. Vol. ii		1917	Library Grant.
Roentgenographic Diagnosis of Dental Infection in Systemic Diseases. By Sinclair Tousey		1916	,, ,,
The Endemic Diseases of the Southern States. By W. H. Deadrick and L. Thompson		1916	,, ,,
Annual Report of the Surgeon-General of the Public Health Service of the United States for the Fiscal Year 1916		1916	Editor, Journal.
Proceedings of the Medical Association of the Isthmian Canal Zone for the half year January, 1916, to June, 1916		1917	,, ,,
Commonwealth of Australia. Department of Trades and Customs. Report on Infantile Mortality		1917	,, ,,
University of Pennsylvania. 13th Report of the Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis		1917	,, ,,
Shell-Shock and its Lessons. By G. E. Smith and T. H. Pear		1917	,, ,,
Medical Manual (War), India. Provisional. (Reprinted with Corrections to January 1, 1917)			Commandant's Office.
The British Guiana Medical Annual for 1915. Edited by A. J. Craigen and F. G. Rose		1916	,, ,,
Metropolitan Borough of Poplar. Annual Report, 1916		1917	,, ,,
Journal of the Royal Naval Medical Service, July, 1917		1917	The Editor.
Further Report on the Tsetse Fly Disease or Nagana, in Zululand. By Surg.-Major David Bruce, A.M.S.		1897	Presented by Surg.-Gen. Sir D. Bruce, C.B., F.R.S.
Appendix to Further Report on the Tsetse Fly Disease or Nagana in Zululand. By Lieut.-Col. David Bruce, F.R.S., R.A.M.C.		1903	,, ,,
A Regimental Surgeon in War and Prison. By Capt. R. V. Dolby, R.A.M.C.		1917	Presented by Lieut.-Col. G. E. Twiss, C.M.G., R.A.M.C.
At the War. By Lord Northcliffe		1916	,, ,,
The Military Surgeon. July, 1917		1917	,, ,,
Columbia Alumni News. July, 1917		1917	,, ,,
The Geographical Journal. August, 1916, to July, 1917		1916-17	Presented by Col. R. J. Simpson, C.M.G., A.M.S.

THE LATE SURGEON-GENERAL SIR WILLIAM TAYLOR, K.C.B.

SEVERAL friends and former comrades of the above officer having expressed a desire to perpetuate his memory in some suitable manner, a small Committee has been formed in order to carry out the proposal, viz.:—

Sir Alfred Keogh (Chairman),
Sir John Furley, Sir William Babtie,
Sir Launcelotte Gubbins, Col. C. R. Tyrrell (Hon. Secretary and Treasurer).

The suggestion is that the subscription should, ordinarily, be a guinea; but any larger or smaller sum will be gratefully received, and as soon as the promised amount can be approximately ascertained, a decision will be come to as to the most suitable form of memorial to be adopted.

Donations may be sent either by cheque or crossed P.O. to Col. C. R. Tyrrell, 5, The Green, Wimbledon Common, S.W., or may be paid direct (marked "Taylor Memorial Fund") to Sir Charles McGrigor, Bart., and Co., 39, Panton Street, Haymarket, S.W.

London, May, 1917.

AUXILIARY R.A.M.C. FUND.

THE Annual General Meeting will be held at the Royal Army Medical College, Grosvenor Road, on October 26, 1917, at 3 p.m.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, Serle Street, London, W.C., not later than the 22nd of the month.

Captain R.A.M.C., regular, 9½ years' service, at present at Base, B.E.F., desires exchange with regular officer in Egypt, Palestine, Mesopotamia, India, or West Coast. A. H. T., c/o G. Street and Co., Ltd., 8, Serle Street, London, W.C. 2.

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS," 324, Adastral House, Victoria Embankment, E.C. 4.

Communications have been received from Colonel G. T. Rawsley; Lieutenant-Colonels A. J. Hull, E. J. Williams; Majors J. C. Kennedy, O. H. Williams; Captains A. C. E. Gray, A. T. Nankivell, A. B. Porteous, J. E. MacIlwaine, A. D. Brunwin, A. V. Poyser, J. L. Rentoul, G. Graham, P. T. Priestley, W. MacAdam, E. B. Gunsor, E. M. Cowell, A. B. Aitken, T. G. Brown, R. M. Stewart, C. S. O'Neill, H. Driffield Levick, C. E. Sundell, F. W. Watkyn Thomas; Lieutenant T. Howell; Lieutenant and Quartermaster R. D. Matthews; S. A. K. Wilson, Esq.

The following publications have been received:—

British: The Medical Journal of South Africa, The Medical Press and Circular, Veterinary Review, Tropical Diseases Bulletin, Guy's Hospital Gazette, Public Health, The Hospital, The Practitioner, The Royal Engineers Journal, The Journal of State Medicine, The St. Thomas's Hospital Gazette, Recalled to Life.

Foreign: Archives de Médecine et Pharmacie Navales, Bulletin of the Johns Hopkins Hospital, Le Caducée, Office International d'Hygiène publique, Colonies et Marine.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London, S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

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JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

NOVEMBER, 1917.

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
August 7, 1917.

THE names of the undermentioned have been brought to the notice of the Secretary of State for War for valuable services rendered in connexion with the War.

Lieut.-Col. F. W. Begbie, Royal Army Medical Corps.
Surg-Gen. Sir D. Bruce, Kt., C.B., F.R.S., M.B., F.R.C.P., Army Medical Service.
Qmr. and Hon. Major A. Bruce, Royal Army Medical Corps.
Major (Temp. Lieut.-Col.) R. M. Carter, F.R.C.S. Edin., Indian Medical Service.
Lieut.-Col. S. A. M. Copeman, M.D., F.R.S., T.D., Royal Army Medical Corps (T.F.
Temp. Hon. Capt. Flack, W.M., Royal Army Medical Corps.
Capt. A. G. R. Foulerton, F.R.C.S., Royal Army Medical Corps (T.F.).
Capt. H. G. Gibson, Royal Army Medical Corps.
Capt. F. L. Golla, M.B., Royal Army Medical Corps (T.F.).
Qmr. and Hon. Lieut. A. Harwood, Royal Army Medical Corps.
Temp. Hon. Major T. G. M. Hine, M.D., Royal Army Medical Corps.
Temp. Hon. Lieut.-Col. H. R. Kenwood, M.B., Royal Army Medical Corps. (Major, Royal Army Medical Corps, T.F.)
Lieut.-Col. Sir A. Newsholme, K.C.B., Royal Army Medical Corps (T.F.).
Temp. Capt. H. S. Raper, M.B., Royal Army Medical Corps.
Temp. Qmr. and Hon. Lieut. J. Ritchie, Royal Army Medical Corps.
Temp. Hon. Lieut.-Col. J. Robertson, M.D., Royal Army Medical Corps.
Temp. Capt. F. R. Seymour, Royal Army Medical Corps.
Capt. W. C. Smales, D.S.O., Royal Army Medical Corps.
Lieut.-Col. J. Tidbury, M.D., Royal Army Medical Corps.
Qmr. and Hon. Major J. Watkins, Royal Army Medical Corps.
Lieut.-Col. A. L. A. Webb, C.M.G., Royal Army Medical Corps.
Qmr. and Hon. Lieut. J. W. Willsher, Royal Army Medical Corps.
No. 4962 Serjt. (Acting Staff Serjt.) J. Matheson, Royal Army Medical Corps, St. Helena.
Capt. W. V. Corbett, Royal Army Medical Corps.

CORRIGENDA.

The undermentioned whose names were brought to the notice of the Secretary of State for War for valuable services rendered in connexion with the War, published in the Press, February 24, 1917, are now correctly described :—

No. 19202 Serjt. F. J. R. Baiden, Royal Army Medical Corps.
No. 25687 Cpl. T. R. Barker, Royal Army Medical Corps.
No. 8770 Acting Serjt. Major J. Grossman, Royal Army Medical Corps.

No. 12660 Serjt. E. Hemsley, Royal Army Medical Corps.
No. 11272 Serjt. Major B. Holmes, Royal Army Medical Corps.
No. 9360 Serjt-Major A. Horn, Royal Army Medical Corps.
No. 26793 Serjt. H. Langmaid, Royal Army Medical Corps.
No. 100834 Pte. A. Locke, Royal Army Medical Corps.
No. 19023 Acting Serjt.-Major A. Tarbet, Royal Army Medical Corps.
No. 29578 Cpl. G. Trebble, Royal Army Medical Corps.

War Office,
October 18, 1917.

His Majesty the King has been pleased to confer the undermentioned rewards for gallantry and distinguished service in the Field :—

The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable.

AWARDED BAR TO MILITARY CROSS.

Temp. Capt. Oswald John Day, M.C., M.B., Royal Army Medical Corps (M.C. gazetted June 18, 1917).

Temp. Capt. Archibald Fullerton, M.C., M.B., Royal Army Medical Corps (M.C. gazetted January 1, 1917).

Temp. Capt. Noel John Hay Gavin, M.C., Royal Army Medical Corps (M.C. gazetted June 4, 1917).

Temp. Capt. Arthur John Rushton O'Brien, M.C., M.B., African Medical Service (M.C. gazetted February 13, 1917).

Temp. Capt. David James Sheiress Stephen, M.C., M.B., Royal Army Medical Corps (M.C. gazetted July 24, 1915).

AWARDED THE MILITARY CROSS.

Capt. John Alston, Royal Army Medical Corps (Special Reserve).
Capt. Robert Ringrove Gelston Atkins, Royal Army Medical Corps (Special Reserve).
Temp. Capt. Phillippe Bernard Belanger, Royal Army Medical Corps.
Capt. William Somerset Birch, Royal Army Medical Corps (Special Reserve).
Temp. Capt. Archibald Grainger Bisset, M.B., Royal Army Medical Corps.
Capt. Arthur Bloom, M.D., Royal Army Medical Corps.
Temp. Capt. Oswald Vincent Burrows, M.B., Royal Army Medical Corps.
Temp. Capt. Charles Kingsley Carroll, Royal Army Medical Corps.
Temp. Capt. John Percival Charles, M.B., Royal Army Medical Corps.
Temp. Capt. Andrew Tocher Cunningham, M.B., Royal Army Medical Corps.
Temp. Capt. Lionel Montrose Dawson, M.D., Royal Army Medical Corps.
Temp. Capt. Harold John de Brent, Royal Army Medical Corps.
Temp. Capt. Carl Keating Graeme Dick, Royal Army Medical Corps.
Temp. Capt. James Dickson, Royal Army Medical Corps.
Lieut. Louis du Vergé, Royal Army Medical Corps.
Temp. Capt. Henry Hawes Elliot, M.B., Royal Army Medical Corps.
Temp. Capt. Henry Vincent Forster, M.B., Royal Army Medical Corps.
Temp. Capt. Cosmo William Fowler, M.B., Royal Army Medical Corps.
Temp. Capt. James Harcourt Cecil Gatchell, Royal Army Medical Corps.
Temp. Lieut. John Alan Campbell Greene, Royal Army Medical Corps.
Capt. David Alexander Ross Haddon, M.B., Royal Army Medical Corps.
Capt. John Livingston Hamilton, Royal Army Medical Corps.
Temp. Capt. David Cochrane Hanson, M.B., Royal Army Medical Corps.
Temp. Capt. Arthur Randell Jackson, M.B., Royal Army Medical Corps.
Capt. Charles Llewellyn Lander, Royal Army Medical Corps.
Capt. Harold Dunmore Lane, Royal Army Medical Corps.
Capt. Peter MacCullum, M.B., Royal Army Medical Corps (Special Reserve).
Temp. Capt. Donald John Macdougall, M.B., Royal Army Medical Corps.
Capt. Albert Edward Peel McConnell, Royal Army Medical Corps.
Temp. Capt. Douglas Charles Murray Page, Royal Army Medical Corps.
Capt. William Barry Postlewaite, M.B., Royal Army Medical Corps (Special Reserve).
Capt. James Wilfred George Hewat Riddel, Royal Army Medical Corps.
Temp. Capt. William Russell, M.B., Royal Army Medical Corps.
Capt. James Bethune Scott, M.B., Royal Army Medical Corps, Special Reserve.
Temp. Capt. Edward Sequier Sowerby, M.B., Royal Army Medical Corps.
Temp. Capt. William Turner, Royal Army Medical Corps.

Lieut. Samuel Vidot, Royal Army Medical Corps, Special Reserve.
Temp. Capt. John Alexander Vlasto, Royal Army Medical Reserve.

CANADIAN FORCE.

Capt. Thomas Herbert Bell, Army Medical Corps.
Capt. John Philip Selby Cathcart, Army Medical Corps.
Capt. Franklin Fletcher Dunham, Army Medical Corps.
Capt. Emmet Andrew McCusker, Army Medical Corps.
Capt. Arthur Allam Parker, Army Medical Corps.
Capt. Stanley Graham Ross, Army Medical Corps.
Capt. William Henry Scott, Army Medical Corps.
Capt. James Walter Woodley, Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the under-mentioned Non-commissioned Officers and Man :—

No. 30210 Staff-Serjt. W. Eldridge, Royal Army Medical Corps (Bexhill).
No. 435013 Sjt. T. E. Garland, Royal Army Medical Corps (Birmingham). (M.M. gazetted, October 21, 1916.)
No. 32266 Pte. A. M. McDonnell, Royal Army Medical Corps (Hampstead). (M.M. gazetted December 21, 1916.)
No. 303039 Cpl. G. M. Lawson, Royal Army Medical Corps (Aberdeen). (M.M. gazetted July 9, 1917.)

His Majesty the King has been graciously pleased to award the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men :—

No. 301308 Lance-Cpl. J. Aitken, Royal Army Medical Corps (Peterhead).
No. 35709 Pte. W. Anderson, Royal Army Medical Corps (Elgin).
No. 50249 Pte. J. Armstrong, Royal Army Medical Corps (Motherwell).
No. 73416 Pte. P. Bairstow, Royal Army Medical Corps (Cornholme).
No. 30325 Serjt. J. H. Barker, Royal Army Medical Corps (Bolton).
No. 43409 Cpl. P. F. Barker, Royal Army Medical Corps (Llandrindod).
No. 90503 Pte. F. J. Batchelor, Royal Army Medical Corps (Bradford-on-Avon).
No. 439216 Pte. H. G. Bird, Royal Army Medical Corps (Bristol).
No. 45012 Pte. J. H. Bradley, Royal Army Medical Corps (Hednesford).
No. 38027 Pte. E. J. Brounhill, Royal Army Medical Corps (Nechells).
No. 46806 Pte. J. H. Brownlee, Royal Army Medical Corps (N. Shields).
No. 301343 Pte. R. Buchan, Royal Army Medical Corps (Aberdeen).
No. 32931 Pte. G. Carter, Royal Army Medical Corps (Small Heath).
No. 53102 Pte. D. Chapel, Royal Army Medical Corps (Dalston).
No. 457015 Serjt. S. J. Collins, Royal Army Medical Corps (Teignmouth).
No. 337255 Pte. W. Cormode, Royal Army Medical Corps (Liverpool).
No. 72277 Pte. (Acting Serjt.) E. A. Cradduck, Royal Army Medical Corps (Chatham).
No. 47387 Pte. F. H. Creasy, Royal Army Medical Corps (Bracebridge).
No. 40458 Pte. F. W. L. Cross, Royal Army Medical Corps (Paddington).
No. 66014 Pte. P. S. Cross, Royal Army Medical Corps (Birmingham).
No. 461043 Pte. W. H. Cullip, Royal Army Medical Corps (Gosport).
No. 303241 Pte. H. A. Daly, Royal Army Medical Corps (Aberdeen).
No. 48933 Pte. W. E. Davies, Royal Army Medical Corps (Nantyglo).
No. 81323 Pte. G. Dickson, Royal Army Medical Corps (Jedburgh).
No. 316248 Pte. J. Donald, Royal Army Medical Corps (Govan).
No. 316420 Pte. J. Dunlop, Royal Army Medical Corps (Glasgow).
No. 65938 Serjt. C. Earl, Royal Army Medical Corps (Tottenham).
No. 459017 Staff-Serjt. F. J. Ellis, Royal Army Medical Corps (Plymouth).
No. 65994 Pte. T. Eustace, Royal Army Medical Corps (Merton).
No. 45745 Pte. N. S. Evans, Royal Army Medical Corps (Glasshoughton).
No. 67183 Pte. S. Fletcher, Royal Army Medical Corps (E. Widnes).
No. 35022 Pte. J. Foster, Royal Army Medical Corps (Newton).
No. 45583 Pte. W. Francis, Royal Army Medical Corps (Horsham).
No. 301100 Pte. J. W. Gallagher, Royal Army Medical Corps (Aberdeen).
No. 34637 Pte. (Acting Serjt.) G. Garry, Royal Army Medical Corps (Lochore).
No. 461233 Pte. A. Goddard, Royal Army Medical Corps (Gosport).
No. 457004 Acting Serjt. F. Harris, Royal Army Medical Corps (Exeter).
No. 341097 Pte. E. Highcock, Royal Army Medical Corps (St. Helens).
No. 49253 Pte. A. E. Hill, Royal Army Medical Corps (Tottenham).
No. 55742 Pte. S. A. Hogg, Royal Army Medical Corps (Hunters Bar).

No. 41663 Pte. J. Horrocks, Royal Army Medical Corps (Orrell).
No. 88053 Pte. V. H. Keppy, Royal Army Medical Corps (Dalston, N.).
No. 79193 Pte. T. B. Kersey, Royal Army Medical Corps (Liverpool).
No. 62387 Pte. J. Killingbeck, Royal Army Medical Corps (Haslingden).
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No. 65775 Serjt. F. W. Loakes, Royal Army Medical Corps (Northampton).
No. 74179 Pte. E. Manning, Royal Army Medical Corps (Chard).
No. 63252 Pte. J. L. I. Marston, Royal Army Medical Corps (Keighley).
No. 47384 Serjt. W. McBrien, Royal Army Medical Corps (Clayhoe).
No. 301198 Pte. W. M. McGregor, Royal Army Medical Corps (Fraserburgh).
No. 301535 Pte. J. McIntosh, Royal Army Medical Corps (Cornhill, Banff).
No. 44157 Pte. S. Meredith, Royal Army Medical Corps (Cadoxton).
No. 473414 Lance-Cpl. C. R. Mills, Royal Army Medical Corps (Godalming).
No. 305038 Lance-Cpl. A. Mitchell, Royal Army Medical Corps (Dundee).
No. 457285 Pte. L. E. Mitchell, Royal Army Medical Corps (Penzance).
No. 39457 Pte. W. H. Owers, Royal Army Medical Corps (Braintree).
No. 451188 Pte. E. Palmer, Royal Army Medical Corps (Woolston).
No. 44790 Pte. J. Pellow, Royal Army Medical Corps (Lochgelly).
No. 55355 Pte. T. Phœnix, Royal Army Medical Corps (Spennymoor).
No. 457173 Staff-Serjt. W. C. Pitman, Royal Army Medical Corps (Exmouth).
No. 316438 Pte. E. F. Porteous, Royal Army Medical Corps (Glasgow).
No. 6515 Cpl. D. Querney, Royal Army Medical Corps (Dublin).
No. 53854 Pte. J. T. Reynolds, Royal Army Medical Corps (Sutton Coldfield).
No. 35490 Pte. E. C. Roberts, Royal Army Medical Corps (Abercarn).
No. 7740 Pte. A. Rogers, Royal Army Medical Corps (Wigan).
No. 93279 Pte. N. B. Rowe, Royal Army Medical Corps (Margate).
No. 461042 Pte. S. F. Rowe, Royal Army Medical Corps (Gosport).
No. 54738 Pte. W. G. Sampson, Royal Army Medical Corps (Brighton).
No. 27910 Pte. L. Say, Royal Army Medical Corps (Bridgend).
No. 42032 Pte. R. A. Scott, Royal Army Medical Corps (Bridgetown).
No. 74443 Serjt. C. H. Searle, Royal Army Medical Corps (Exeter).
No. 44803 Serjt. V. J. Selby, Royal Army Medical Corps (S. Shields).
No. 301417 Pte. A. M. F. Silver, Royal Army Medical Corps (Aberdeen).
No. 90135 Cpl. W. P. Simpson, Royal Army Medical Corps (Falkirk).
No. 545158 Pte. (Acting Serjt.) C. Snell, Royal Army Medical Corps (Talywarn).
No. 3685 Pte. (Acting-Cpl.) A. Stapleton, Royal Army Medical Corps (Torrington)
No. 47091 Serjt. W. D. Strong, Royal Army Medical Corps (Hull).
No. 301260 Pte. A. H. Taylor, Royal Army Medical Corps (Aberdeen).
No. 72130 Pte. T. Taylor, Royal Army Medical Corps (Prittlewell).
No. 75635 Pte. B. W. Thompson, Royal Army Medical Corps (Rotherham).
No. 30696 Pte. F. Tolhurst, Royal Army Medical Corps (Walton).
No. 439211 Cpl. L. Weeks, Royal Army Medical Corps (St. George).
No. 34377 Pte. E. J. Wesson, Royal Army Medical Corps (Stepney).
No. 30327 Serjt. H. Wilkinson, Royal Army Medical Corps (Warrington).
No. 81931 Pte. J. Williams, Royal Army Medical Corps (Liverpool).
No. 46985 Pte. C. W. Wilson, Royal Army Medical Corps (Hope-under-Dinmore).
No. 303288 Pte. G. Wood, Royal Army Medical Corps (Aberdeen).

AMENDMENTS.

The following is the correct description of the officer mentioned upon whom a reward has recently been conferred :--

Temp. Lieut. David Hammond Fraser, M.B., M.C., Royal Army Medical Corps, attached R.F.A. (M.C. gazetted September 17, 1917).

War Office,
October 22, 1917.

His Majesty the King has been graciously pleased to award a Bar to the Distinguished Conduct Medal, and the Distinguished Conduct Medal respectively, to the undermentioned Non-commissioned Officers.

The acts of gallantry for which the decorations have been conferred will be published in the *London Gazette* next month if practicable :—

AWARDED A BAR TO DISTINGUISHED CONDUCT MEDAL.

No. 45510 Serjt. H. W. Abbiss, Royal Army Medical Corps (Cromer). (D.C.M. gazetted October 20, 1916.)

No. 40658 Cpl. (Acting Serjt.) H. Goodwin, Royal Army Medical Corps (Lewisham). (D.C.M. gazetted August 16, 1917.)

AWARDED THE DISTINGUISHED CONDUCT MEDAL.

No. 12377 Qmr.-Serjt. (Temp. Serjt.-Major) B. L. Aldous, Royal Army Medical Corps (Dublin).
No. 473174 Pte. F. Bass, Royal Army Medical Corps (Needham Market).
No. 71883 Pte. (Acting-Cpl.) M. G. A. Brooke, Royal Army Medical Corps (Nottingham).
No. 508112 Cpl. (Acting-Serjt.) C. F. Clarkson, Royal Army Medical Corps (Crouch Hill, N.).
No. 46289 Cpl. J. Cooper, Royal Army Medical Corps (Bethnal Green).
No. 316293 Pte. W. S. Donald, Royal Army Medical Corps (Golspie, Sutherland).
No. 341023 Serjt. J. Drury, Royal Army Medical Corps (St. Helens)
No. 459089 Pte. C. S. J. Duke, Royal Army Medical Corps (Plymouth).
No. 47672 Acting-Cpl. W. Eastick, Royal Army Medical Corps (Norwich).
No. 4811 Cpl. A. H. Franklin, Royal Army Medical Corps (Staines).
No. 341040 Serjt. W. Gee, Royal Army Medical Corps (St. Helens).
No. 59602 Pte. H. R. Grahnert, Royal Army Medical Corps, attached Machine Gun Corps (Wimbledon Park).
No. 30893 Serjt. J. Hardy, Royal Army Medical Corps (W. Hartlepool).
No. 446012 Serjt. E. Honey, Royal Army Medical Corps (Maidenhead).
No. 48068 Serjt. F. J. King, Royal Army Medical Corps (Ogmore Vale).
No. 305053 Serjt. E. Mann, Royal Army Medical Corps (Dundee).
No. 316200 Serjt. C. Scullin, Royal Army Medical Corps (Glasgow).
No. 301338 Serjt. W. Sutherland, Royal Army Medical Corps (Wick).
No. 320 Pte. (Acting-Cpl.) H. Tallon, Royal Army Medical Corps (Brighton).
No. 491 Pte. R. Underwood, Royal Army Medical Corps (Birmingham).

War Office,
October 27, 1917.

His Majesty the King has been pleased to confer the undermentioned rewards for gallantry and Distinguished Service in the Field.

The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable:—

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. John Caruthers Sale, M.C., Royal Army Medical Corps.

AWARDED BAR TO THE MILITARY CROSS.

Temp. Capt. Hugh Ross MacIntyre, M.C., Royal Army Medical Corps (M.C., gazetted August 16, 1917).

AWARDED THE MILITARY CROSS.

Temp. Lieut. Henry Marston Layard Crawford, M.D., Royal Army Medical Corps.
Temp. Qmr. and Hon. Lieut. Charles Elliot, Royal Army Medical Corps.
Temp. Capt. Leslie Haden Guest, Royal Army Medical Corps.
Temp. Capt. William Llewellyn Aplin Harrison, Royal Army Medical Corps.
Temp. Capt. William George Johnston, Royal Army Medical Corps.
Temp. Capt. Robert Kennon, M.D., Royal Army Medical Corps.
Temp. Capt. John Kirton, M.B., Royal Army Medical Corps.
Temp. Capt. Wilfred John Pearson, M.B., Royal Army Medical Corps.

ISSUED WITH ARMY ORDERS DATED NOVEMBER 1, 1917.

FOREIGN MEDALS.

The following are among the Medals awarded by the Allied Powers at various dates to the British Forces for distinguished services rendered during the course of the campaign:—

His Majesty the King has given unrestricted permission in all cases to wear the Medals in question.

MEDALS CONFERRED BY H.M. THE KING OF SERBIA.

Silver Medal.

No. 101982 Pte. Walter Blackett, Royal Army Medical Corps (Crook, Durham).
No. 74017 Pte. Charles Brewer, Royal Army Medical Corps (Erdington, Birmingham).

No. 26029 Pte. William Bartholomew Whitbread, Royal Army Medical Corps (Primrose, Lancaster).

ARMY MEDICAL SERVICE.

Col. Frederick William Caton Jones, C.B., M.B., is placed on retired pay, dated August 24, 1917. (Substituted for the notification in the *Gazette*, September 3, 1917.)

Temp. Surg.-Gen. Sir G. H. Makins, K.C.M.G., C.B., F.R.C.S., to rank as Lieut.-Gen. whilst specially employed, dated October 19, 1917.

ROYAL ARMY MEDICAL CORPS.

Major William G. Maydon relinquishes the acting rank of Lieut.-Col. on reposting, dated January 21, 1917.

Major Richard E. Humfrey, M.B., to be Acting Lieut.-Col. whilst in command of a Field Ambulance, dated October 8, 1917.

The appointment of the undermentioned as Temp. Majors is antedated to August 16, 1915:—

Capt. (Acting Lieut.-Col.) Arthur D. O'Carroll, M.B.

Lieut.-Col. (Temp. Col.) Peter MacKessack, D.S.O., M.B., relinquishes the rank of Temp. Col. on reposting, dated July 25, 1917.

Major (Temp. Lieut.-Col.) Charles W. Holden, D.S.O., to be an Assistant Director of Medical Services of a Division, and to retain his temporary rank, dated July 26, 1917.

Major (Acting Lieut.-Col.) William L. Steele retains his acting rank whilst in command of a General Hospital, dated December 4, 1916.

The undermentioned to be Acting Lieut.-Cols. whilst in command of a General Hospital:—

July 11, 1917.—Major Charles H. Carr, M.D.,; Temp. Major Ernest W. Skinner, M.D.

August 1, 1917.—Major Frederick J. Garland, M.B., whilst in command of a Casualty Clearing Station.

The undermentioned to be Acting Lieut.-Cols. whilst in command of a Field Ambulance:—

September 10, 1917.—Capt. William W. Boyce: Lieut. (Temp. Capt.) Richard A. Preston, M.C., M.B.

ARMY MEDICAL OFFICERS' WIDOWS AND ORPHANS FUND.

SUMMARY OF THE PROCEEDINGS OF A QUARTERLY MEETING OF THE COMMITTEE HELD AT THE ROYAL ARMY MEDICAL COLLEGE ON OCTOBER 24, 1917.

Present:

Deputy Surg.-Gen. W. G. Don, Vice President, in the Chair.
Surg.-Gen. W. S. M. Price, Vice President.
Lieut.-Col. J. More Reid.
Lieut.-Col. G. S. Mansfield.
The Secretary.

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(1) The Minutes of the previous meeting were read and confirmed.

(2) Major (Temp. Lieut.-Col.) A. C. H. Gray was admitted a married member of the Society at an annual subscription of £19 14s., together with an additional war charge of £26 5s. per annum, to July 24, 1917.

(3) The death was reported of Lieut.-Col. A. F. S. Clarke, on August 11, and his widow was placed on the list of annuitants.

(4) In view of the half-yearly interest on £124,000 5 per cent. War Stock, 1929-47, due to the Society on December 1, it was resolved that a sum, not exceeding £3,000, from the cash balance available on that date be, with the consent of the trustees, invested in either 5 per cent. War Stock, 1929-47, or in 5 per cent. National War Bonds as may be considered advisable by Sir James McGrigor and Mr. Andras; and that the Secretary be empowered to take the necessary action.

(5) Payment of annuities for the coming half-year to widows on the list submitted was sanctioned.

(6) Payment of the Secretary's salary, &c., for the quarter ended September 30, 1917, was sanctioned.

This Fund provides annuities of £50 a year (together with any additional benefits which may be available from distribution of surplus), to the widows of subscribers and to their children under 21 years of age. The annual subscription varies according to the age of husband and wife: e.g., in the case of a husband aged 30, and wife aged 25, it would amount to £14 18s. 6d.; where husband and wife were both aged 28 it would be £12 19s. 11d. At the outbreak of war an additional war charge of 50 guineas per annum was made, and eligibility for membership was limited to officers on the strength of the Corps on that date.

The death rate amongst officers of the Corps having been lower in the later stages of the war than was expected the Committee have been able to reduce the extra war charge to one of 25 guineas per annum, in addition to the normal annual subscription according to scale. It has also been resolved that officers gazetted to permanent commissions in the Corps on January 1, 1917, and up to May 22, 1917, shall be eligible for membership, on the above terms. The cases of those who may be gazetted later will be considered as they arise.

The Secretary will be glad to give any further information as to details.

J. T. Clapham,
Captain, Secretary,

3, *Holmfield Road,*
Wimbledon, S.W. 19.

October 19, 1917.

Major R. G. Anderson has by deed poll of August, 1917 (in common with the other members of my family), changed his surname from Anderson to Gayer-Anderson.

BIRTH.

MACKENZIE.—On September 15, at Great Chart, near Ashford, Kent, the wife of Capt. (Temp. Lieut.-Col.) D. F. Mackenzie, R.A.M.C., of a daughter.

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, *Serle Street, London, W.C., not later than the* 22nd *of the month.*

WANTED.—The following numbers of the R.A.M.C. Journal: February, March, and November, 1916, and January, 1917. Will Officers having all or any of these numbers to spare kindly communicate with the O.C., 2nd London Sanitary Company, Duke of York's Headquarters, Chelsea, S.W. 3?

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates:—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of EXCERPTS *	Extra for Covers for Reprints: As Journal, Printed on Front	Extra for Covers for Reprints: As Journal, Plain, Unprinted	Extra for Covers for Reprints: Cheaper Paper, Printed on Front	Extra for Covers for Reprints: Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
12	4	0 2 9	0 1 2	4 8	1 1	3 10	0 9
	8	0 5 0	0 2 3				
	16	0 8 3	0 3 11				
25	4	0 3 4	0 1 5	4 10	1 6	4 4	0 11
	8	0 6 0	0 2 9				
	16	0 10 6	0 5 0				
50	4	0 4 6	0 1 10	6 0	2 1	4 10	1 2
	8	0 7 6	0 3 6				
	16	0 13 3	0 5 10				
100	4	0 6 0	0 3 1	7 10	3 11	6 7	2 5
	8	0 10 0	0 4 10				
	16	0 18 6	0 7 6				
200	4	0 9 6	0 4 5	10 10	7 6	9 0	4 10
	8	0 15 0	0 6 7				
	16	1 6 0	0 9 8				

* These are not arranged as Reprints, but appear precisely as in the Journal with any other matter that may happen to appear on the first and last pages of the particular excerpt ordered.

Cases for Binding Volumes.—Strong and useful cases for binding can be obtained from the publishers at the undermentioned rates:—

Covers, 2s. net; binding, 2s.

These charges are exclusive of cost of postage.

In forwarding parts for binding the name and address of sender should be enclosed in parcel.

The above figures are subject to 25 per cent. increase.

Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths **are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "Journal of the Royal Army Medical Corps,"** 324, Adastral House, Victoria Embankment, E.C. 4.

Communications have been received from Colonel Gordon Holmes; Lieutenant-Colonel L. F. Smith; Major S. W. Plummer: Captains T. H. Somervell, J. L. Yuill, K. A. MacLean, B. Hughes, H. S. Banks, A. M. Watts; Lieutenant F. B. Chavasse; G. L. Preston, Esq.

The following publications have been received:—

British: Bulletin of Entomological Research, Transactions of the Society of Tropical Medicine and Hygiene, The Medical Journal of South Africa, The Hospital, Annals of Tropical Medicine and Parasitology, The Medical Press and Circular, The Medical Review, Guy's Hospital Gazette, The Medical Journal of Australia, The Royal Engineers' Journal, The Journal of Tropical Medicine and Hygiene, St. Bartholomew's Hospital Journal, The Practitioner, Public Health, Tropical Veterinary Bulletin, Tropical Diseases Bulletin, The Middlesex Hospital Journal, Journal of the Royal Naval Medical Service, The Journal of State Medicine, The British Journal of Surgery, Journal of the Royal Sanitary Institute, The Quarterly Journal of Medicine, The Indian Journal of Medical Research, The Indian Medical Gazette, Veterinary Review.

Foreign: Archives Medicales Belges, Giornale di Medicina Militaire, Annali di Medicina Navale e Coloniale, Bulletin de l'Institut Pasteur, United States Department of Agriculture, Revista de la Sanidad Militar Colonies et Marine, The Journal of Infectious Diseases, Tidskrift i Militär Hälsovärd, Office International d'Hygiène publique, The Military Surgeon, L'Ospedale Maggiore, United States Public Health Services, Archives de Medecine et Pharmacie Navales, Archives de Medecine et de Pharmacie, Bulletin de la Société de Pathologie exotique.

MANAGER'S NOTICES.

The Journal of the Royal Army Medical Corps is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

The Annual Subscription is £1 (which includes postage), and should commence either on 1st July or 1st January; but if a subscriber wishes to commence at any other month he may do so by paying for the odd months between 1st July and 1st January at the rate of 1s. 8d. (one shilling and eightpence) per copy. (All subscriptions are payable in advance.)

Single copies can be obtained at the rate of 2s. per copy.

The Corps News is also issued separately from the Journal, and can be subscribed for at the rate of 2s. (two shillings) per annum, including postage. Subscriptions should commence from 1st July each year; but if intending subscribers wish to commence from any other month, they may do so by paying for the odd months at the rate of 2d. per copy. (All subscriptions are payable in advance.)

Officers of the Royal Army Medical Corps possessing Diplomas in Public Health, etc., are kindly requested to register their special qualifications at the War Office. Letters of complaint are frequently received from officers stating that their special qualifications have not been shown in the Distribution List which is published as a supplement to the Journal in April and October of each year. As, however, the particulars of this list are supplied from official sources, officers are reminded that unless the possession of Diplomas, etc., has been registered at the War Office, no entry of such qualifications can be recorded in the Distribution List.

Letters notifying change of address should be sent to the Hon. Manager, "Journal of the Royal Army Medical Corps," War Office, Whitehall, London S.W., and must reach there not later than the 20th of each month for the alteration to be made for the following month's issue.

It is requested that all Cheques or Postal Orders for Subscriptions to the Journal, Corps News, Reprints, etc., be crossed "Holt & Co.," and made payable to the "Hon. Manager, Journal R.A.M.C.," and not to any individual personally.

All communications for the Hon. Manager regarding subscriptions, etc., should be addressed to

The Hon. Manager,
"Journal of the Royal Army Medical Corps'
25, Adastral House, Victoria Embankment, E.C. 4.

JOURNAL

OF THE

ROYAL ARMY MEDICAL CORPS.

Corps News.

DECEMBER, 1917.

War Office,
October 31, 1917.

The Government of India has forwarded for publication the following dispatch from General Sir Charles Monro, G.C.M.G., K.C.B., Commander-in-Chief, India, on military operations in the Indian Empire from March 10, 1916, to March 31, 1917:—

Army Headquarters, India,
Simla,
July 23, 1917.

From the Commander-in-Chief in India to the Secretary to the Government of India.

Name of Officer brought to notice for gallantry or good service in the operations dealt with in this dispatch:—

ROYAL ARMY MEDICAL CORPS.

Fawcett, Major, C. E. W. S.

War Office,
November 2, 1917.

His Majesty the King has been graciously pleased to approve of the award of a Bar to the Military Medal to the undermentioned Non-commissioned Officers and Men:—

No. 20331 Pte. R. Fairless, Royal Army Medical Corps (Gateshead-on-Tyne). (Military Medal gazetted December 21, 1916.)

No. 34129 (formerly 1666) Pte. J. Houghton, Royal Army Medical Corps (St. Helens). (Military Metal gazetted January 6, 1917.)

No. 32146 Pte. J. Birse, Royal Army Medical Corps (Carnoustie).

No. 39688 Lance-Cpl. F. D. Rainbow, Royal Army Medical Corps (Leamington Spa).

No. 32982 Serjt. C. W. Smith, Royal Army Medical Corps (Manchester). (Military Medal gazetted July 18, 1917.)

His Majesty the King has been graciously pleased to award the Military Medal for bravery in the Field to the undermentioned Non commissioned Officers and Men:—

No. 341225 Cpl. R. P. Allcock, Royal Army Medical Corps (St. Helens).
No. 435075 Pte. C. L. Allen, Royal Army Medical Corps (Birmingham).
No. 337453 Pte. A. W. Ardran, Royal Army Medical Corps (Liverpool).
No. 337499 Pte. G. H. Armstrong, Royal Army Medical Corps (Wrexham).
No. 508343 Pte. S. Bailey, Royal Army Medical Corps (Leytonstone).
No. 457295 Cpl. H. G. Bartlett, Royal Army Medical Corps (Sidmouth).
No. 68107 Serjt. J. Barton, Royal Army Medical Corps (Canada).
No. 40408 Pte. J. Beech, Royal Army Medical Corps (Northwich).
No. 437002 Pte. W. Bennett, Royal Army Medical Corps (Birmingham).
No. 383575 H. H. Bevan, Royal Army Medical Corps (Sunderland).
No. 510019 Serjt. G. Biddle, Royal Army Medical Corps (Walworth, S.E.).
No. 35418 Pte. E. Binney, Royal Army Medical Corps (Craghead).
No. 341112 Lance-Cpl. C. J. O. Blackmore, Royal Army Medical Corps (Widnes).

No. 31533 Pte. F. Blyth, Royal Army Medical Corps (Canada).
No. 510456 Lance-Cpl. H. Boulton, Royal Army Medical Corps (Burslem).
No. 341229 Pte. J. Brophy, Royal Army Medical Corps (St. Helens).
No. 32147 Pte. J. A. Bury, Royal Army Medical Corps (Burnley).
No. 64772 Pte. G. Campbell, Royal Army Medical Corps (Edinburgh).
No. 5562 Serjt. A. C. J. Caseley, Royal Army Medical Corps (Exeter).
No. 65716 Pte. (Acting Cpl.) W. B. Clouston, Royal Army Medical Corps (Caterham Valley).
No. 73817 Pte. J. P. Conn, Royal Army Medical Corps (Fence Houses).
No. 435334 Pte. J. Cox, Royal Army Medical Corps (Smethwick).
No. 902 Pte. C. Dumsday, Royal Army Medical Corps (Crawley).
No. 457472 Pte. W. H. Dymond, Royal Army Medical Corps (Devon).
No. 510443 Pte. F. G. Ellis, Royal Army Medical Corps (Lindfield).
No. 48348 Pte. J. H. Evans, Royal Army Medical Corps (Coity, Bridgend, Glamorgan).
No. 89068 Pte. J. Flynn, Royal Army Medical Corps (Ryton-on-Tyne).
No. 457090 Pte. F. C. Fursman, Royal Army Medical Corps (Exeter).
No. 341646 Pte. J. Gerrard, Royal Army Medical Corps (St. Helens).
No. 508360 Pte. J. Godbold, Royal Army Medical Corps (Ipswich).
No. 337665 Pte. W. Green, Royal Army Medical Corps (Liverpool).
No. 512402 Pte. C. Greenslade, Royal Army Medical Corps (Crediton).
No. 341628 Pte. P. Harrison, Royal Army Medical Corps (St. Helens).
No. 31550 Pte. W. R. Harrison, Royal Army Medical Corps (Broseley).
No. 510220 Pte. J. N. Hawken, Royal Army Medical Corps (Pimlico).
No. 53667 Pte. J. Hawkins, Royal Army Medical Corps (Deptford).
No. 57357 Pte. J. M. Hindmarch, Royal Army Medical Corps (Sunderland).
No. 90092 Pte. F. Hoare, Royal Army Medical Corps (Westgate-on-Sea).
No. 341136 Pte. G. W. Hopkins, Royal Army Medical Corps (St. Helens).
No. 439506 Pte. W. Hudd, Royal Army Medical Corps (Bristol).
No. 68212 Pte. I. Jolley, Royal Army Medical Corps (Wigan).
No. 10599 Cpl. (Acting Serjt.) H. G. Jupp, Royal Army Medical Corps (Dorchester).
No. 437086 Pte. A. F. N. Lakin, Royal Army Medical Corps (Birmingham).
No. 34174 Acting Lance-Cpl. W. A. Lamb, Royal Army Medical Corps (Clapham).
No. 508196 Pte. A. G. Lee, Royal Army Medical Corps (Muswell Hill).
No. 47639 Pte. J. Limer, Royal Army Medical Corps (Leigh).
No. 37 Pte. W. R. Lovett, Royal Army Medical Corps (Birmingham).
No. 42465 Pte. W. Llewellyn, Royal Army Medical Corps (Bargold).
No. 68253 Serjt. F. Madge, Royal Army Medical Corps (Stroud).
No. 42482 Cpl. (Acting Serjt.) J. E. Meehan, Royal Army Medical Corps (Liverpool).
No. 341336 Pte. M. Mitchell, Royal Army Medical Corps (St. Helens).
No. 508202 Pte. A. Morgan, Royal Army Medical Corps (Kennington).
No. 337100 Serjt. A. N. Morgan, Royal Army Medical Corps (Liverpool).
No. 43091 Pte. E. Nelson, Royal Army Medical Corps (Leigh).
No. 58487 Pte. E. G. Newman, Royal Army Medical Corps (Sheffield).
No. 512548 Lance-Cpl. W. Nurse, Royal Army Medical Corps (Bowes Park).
No. 3674 Pte. J. O'Loughlin, Royal Army Medical Corps (Dublin).
No. 48029 Serjt. W. J. Parker, Royal Army Medical Corps (Aberdare).
No. 510469 Pte. T. W. Pateman, Royal Army Medical Corps (Accrington).
No. 48440 Pte. T. J. Picton, Royal Army Medical Corps (Chester).
No. 457347 Pte. W. L. Pidgeon, Royal Army Medical Corps (Exeter).
No. 3999 Pte. H. Porter, Royal Army Medical Corps (Belfast).
No. 48627 Pte. (Acting Cpl.) W. J. Probert, Royal Army Medical Corps (Merthyr).
No. 65567 Pte. A. Richardson, Royal Army Medical Corps (Chesham).
No. 56617 Pte. J. Riding, Royal Army Medical Corps (Chorley).
No. 37194 Serjt. L. Rollo, Royal Army Medical Corps (Glasgow).
No. 437098 Lance-Cpl. H. L. Rowe, Royal Army Medical Corps (Sheffield).
No. 437308 Pte. F. Rowlands, Royal Army Medical Corps (Birmingham).
No. 439109 Pte. (Acting Cpl.) W. C. Schofield, Royal Army Medical Corps (Bristol).
No. 435585 Staff-Serjt. H. S. Scragg, Royal Army Medical Corps (Oxford).
No. 39221 Pte. H. Sharples, Royal Army Medical Corps (Oldham).
No. 32133 Serjt. W. Smith, Royal Army Medical Corps (Risley).
No. 337482 Pte. T. A. Stanfield, Royal Army Medical Corps (Wallasey).
No. 457211 Pte. W. R. Stile, Royal Army Medical Corps (Devon).
No. 437184 Lance-Cpl. N. Valentine, Royal Army Medical Corps (Birmingham).
No. 37398 Pte. A. Wilkinson, Royal Army Medical Corps (Leigh, Lancs).

No. 241636 Pte. P. E. Williams, Royal Army Medical Corps (St. Helens).
No. 81487 Pte. E. Williamson, Royal Army Medical Corps (Sneinton, Notts).
No. 62004 Pte. T T. W. Wilson, Royal Army Medical Corps (Brecon).
No. 510182 Staff-Serjt. G. Witham, Royal Army Medical Corps (Bow, E.).
No. 47688 Cpl. I. Wolstenholme, Royal Army Medical Corps (Natal).
No. 40259 Pte. E. J. Wright, Royal Army Medical Corps (Ipswich).
No. 510077 Pte. P. Wright, Royal Army Medical Corps (Chelsea).
No. 31804 Pte. W. E. Wykes, Royal Army Medical Corps (Chesterfield).
No. 48221 Pte. O. Young, Royal Army Medical Corps (Cwmcarn, Mon.).

EXTRACTS FROM THE "LONDON GAZETTE."

War Office,
November 19, 1917.

His Majesty the King has been pleased to confer the undermentioned rewards for gallantry and distinguished service in the Field:—

The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable.

Awarded the Distinguished Service Order.

Temp. Capt. Gordon Wilson Armstrong, Royal Army Medical Corps.

Australian Imperial Force.

Major Sydney Vere Appleyard, Army Medical Corps.
Major William Wallace Stewart Johnston, M.C., Army Medical Corps.

Awarded a Bar to the Military Cross.

Capt. William McMeekin Chesney, M.C., M.B., Royal Army Medical Corps (Special Reserve). (M.C. gazetted June 23, 1917.)

Temp. Capt. Robert Welton Hogg, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted December 11, 1916.)

Temp. Capt. Hubert Francis Wilson, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted September 26, 1917.)

South African Force.

Temp. Capt. Maurice Bertram Lawrie, M.C., South African Medical Corps. (M.C. gazetted July 26, 1917.)

Awarded the Military Cross.

Capt. Bernard Gordon Beveridge, Royal Army Medical Corps.
Temp. Capt. Dimock Stanley Cassidy, M.D., Royal Army Medical Corps (Lieut.-Col., Army Medical Corps).
Capt. George Eustace, M.D., Royal Army Medical Corps.
Capt. Frederick George Harper, M.D., Royal Army Medical Corps.
Temp. Capt. James Jack, M.B., Royal Army Medical Corps.
Capt. Harold Haward Leeson, Royal Army Medical Corps.
Temp. Capt. Charles Fellowes Maclachlan, Royal Army Medical Corps.
Temp. Capt. Peter Malcolm MacLachlan, M.D., Royal Army Medical Corps.
Capt. James Stewart McConnachie, Royal Army Medical Corps.
Qmr. and Hon. Lieut. Francis Poole, Royal Army Medical Corps.
Temp. Capt. Alexander Waugh Young, M.D., Royal Army Medical Corps.

Australian Force.

Capt. Vernon Carlisle Brown, Army Medical Corps.
Capt. Charles Hallily Kellaway, Army Medical Corps.
Capt. Patrick Joseph Francis O'Shea, Army Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-commissioned Officers, and Men, for acts of gallantry and devotion to duty in the Field, and a statement of services rendered will be published when practicable:—

No. 37742 Qmr.-Serjt. (Acting Serjt.-Major) F. St. L. Gosley, Royal Army Medical Corps (Edinburgh).

No. 20119 Pte. J. Jones, Royal Army Medical Corps (Newport).

No. 44387 Pte. T. W. H. Newly, Royal Army Medical Corps (York).
No. 41192 Pte. W. F. Quinn, Royal Army Medical Corps (Belfast).
No. 69345 Pte. S. C. Radford, Royal Army Medical Corps (E. Poplar).
No. 497020 Serjt. W. C. Richardson, Royal Army Medical Corps (Tolworth).
No. 56932 Cpl. (Acting Serjt.) W. P. Watson, Royal Army Medical Corps (W. Hartlepool).

The following are the correct descriptions of Non-commissioned Officer, and Man, upon whom honours have been recently conferred:—

No. 12377 Qmr.-Serjt. (Temp. Serjt.-Major) B. L. Aldhous, Royal Army Medical Corps. (D.C.M. gazetted October 22, 1917.)
No. 71883 Pte. (Acting Cpl.) M. F. A. Brooke, Royal Army Medical Corps. (D.C.M. gazetted October 22, 1917.)

His Majesty the King has been graciously pleased to approve of the award of the Military Medal for Bravery in the Field to the undermentioned Non-commissioned Officers and Men:—

No. 78970 Pte. (Lance-Cpl.) B. Bean, Royal Army Medical Corps (Arnside).
No. 341050 Cpl. J. Birchall, Royal Army Medical Corps (St. Helens).
No. 461484 Pte. (Acting Cpl.) H. Blakeley, Royal Army Medical Corps (Bournemouth).
No. 90015 Pte. G. Bone, Royal Army Medical Corps (Luton).
No. 33019 Pte. F. J. Boucher, Royal Army Medical Corps (Hanwell).
No. 83499 Pte. W. R. Boxall, Royal Army Medical Corps (Pimlico, S.W.).
No. 421087 Pte. A. Bunt, Royal Army Medical Corps (Wolverhampton).
No. 7592 Pte. E. Chaney, Royal Army Medical Corps (Middlesborough).
No. 64047 Cpl. G. Chapman, Royal Army Medical Corps (Hunmanby).
No. 41264 Pte. W. Cooke, Royal Army Medical Corps (Belfast).
No. 41163 Staff-Serjt. A. Donnelly, Royal Army Medical Corps (Belfast).
No. 54633 Pte. R. Finch, Royal Army Medical Corps (Preston).
No. 38648 Pte. W. Franklin, Royal Army Medical Corps (Lower Edmonton, London).
No. 75930 Cpl. W. T. Germaney, Royal Army Medical Corps (Greenhithe).
No. 64406 Pte. J. T. Haughan, Royal Army Medical Corps (Kibblesworth).
No. 439488 Pte. F. G. Hockin, Royal Army Medical Corps (Brislington).
No. 352088 Serjt. H. Horne, Royal Army Medical Corps (Burnley).
No. 64125 Pte. (Lance-Cpl.) J. Imrie, Royal Army Medical Corps (Kirkcaldy).
No. 53353 Pte. W. J. McCoy, Royal Army Medical Corps (Portadown).
No. 54753 R. McKay, Royal Army Medical Corps (Randalstown).
No. 64602 Pte. (Acting Cpl.) T. S. Meir, Royal Army Medical Corps (Middlesborough).
No. 47265 Cpl. G. Millar, Royal Army Medical Corps (Belfast).
No. 64010 Pte. A. Munro, Royal Army Medical Corps (Buckhaven).
No. 41350 Pte. S. Neill, Royal Army Medical Corps (Belfast).
No. 41191 Pte. R. Patterson, Royal Army Medical Corps (Belfast).
No. 47259 Pte. J. A. Quinn, Royal Army Medical Corps (Kilburn, N.W.).
No. 42974 Pte. H. Reid, Royal Army Medical Corps (Castlereagh).
No. 30741 Cpl. (Acting Serjt.) J. Richards, Royal Army Medical Corps (Birmingham).
No. 3010 Pte. F. W. Ring, Royal Army Medical Corps (Coventry),
No. 439270 Pte. W. H. S. Roberts, Royal Army Medical Corps (Weston-super-Mare).
No. 41120 Cpl. D. Service, Royal Army Medical Corps (Belfast).
No. 71909 Serjt. F. W. Simcock, Royal Army Medical Corps (Warrington).
No. 435525 Pte. J. W. Sockett, Royal Army Medical Corps (Saltley).
No. 46786 Pte. W. Templeton, Royal Army Medical Corps (Belfast).
No. 417018 Serjt. J. W. Wagg, Royal Army Medical Corps (Derby).
No. 76294 Pte. T. W. Western, Royal Army Medical Corps (Skipton).
No. 538005 Ajt. A. S. White, Royal Army Medical Corps (Pimlico, S.W.).
No. 44998 Pte. A. Whittaker, Royal Army Medical Corps (Rugeley).
No. 53356 Cpl. J. Williamson, Royal Army Medical Corps (Belfast).
No. 439406 Pte. J. Yates, Royal Army Medical Corps (Bristol).

War Office,
November 20, 1917.

The names of the undermentioned Officers and others serving with the British Artillery in Italy have been brought to the notice of the Secretary of State for War for distinguished service in the Field:—

Capt. J. A. Davies, Royal Army Medical Corps (Territorial Force).

Major (Temp. Lieut.-Col.) B. H. V. Dunbar, D.S.O., M.D., Royal Army Medical Corps.

No. 90472 Serjt. H. Mitchell, Royal Army Medical Corps.

War Office,
November 26, 1917.

His Majesty the King has been pleased to confer the undermentioned rewards for gallantry and distinguished service in the Field:—

The acts of gallantry for which the decorations have been awarded will be announced in the *London Gazette* as early as practicable:—

AWARDED A BAR TO DISTINGUISHED SERVICE ORDER.

Major (Temp. Lieut.-Col.) Patrick John Hanafin, D.S.O., Royal Army Medical Corps (D.S.O. gazetted January 14, 1916.)

Temp. Capt. Robert McCowan Hill, D.S.O., Royal Army Medical Corps. (D.S.O. gazetted May 16, 1916.)

AWARDED THE DISTINGUISHED SERVICE ORDER.

Temp. Capt. James Churchill Dunn, M.C., M.D., Royal Army Medical Corps.

Temp. Capt. Ernest Harrison Griffin, M.C., M.D., Royal Army Medical Corps.

Capt. and Brevet-Major Henry Forbes Panton, M.C., M.B., Royal Army Medical Corps.

AUSTRALIAN IMPERIAL FORCE.

Major William Bannerman Craig, Army Medical Corps.

Major William Allan Hailes, Army Medical Corps.

Major Harrie Bertie Lee, M.C., Army Medical Corps.

Major Robert Maxwell McAlister, Army Medical Corps.

NEW ZEALAND FORCE.

Major Kenneth MacCormick, Medical Corps.

AWARDED A BAR TO THE MILITARY CROSS.

Temp. Capt. William Thomson Brown, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted September 26, 1917.)

Temp. Lieut. (Temp. Capt.) Henry Alphonsus Harbison, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted August 25, 1916.)

Temp. Capt. Charles Reginald Ralston Huxtable, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted July 18, 1917.)

Capt. George Reginald Edward Gray Mackay, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted September 22, 1916.)

Temp. Capt. Charles Joseph O'Reilly, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted November 4, 1915.)

Temp. Capt. John Finlayson McGill Sloan, M.C., Royal Army Medical Corps. (M.C. gazetted July 18, 1917.)

Temp. Capt. Gideon Walker, M.C., M.B., Royal Army Medical Corps. (M.C. gazetted November 14, 1916.)

AUSTRALIAN IMPERIAL FORCE.

Capt. Charles Herbert Leedman, M.C., Army Medical Corps. (M.C., gazetted July 18, 1917.)

Capt. Patrick Joseph Francis O'Shea, M.C., Army Medical Corps. (M.C., gazetted November 18, 1917.)

AWARDED THE MILITARY CROSS.

Capt. Charles Henry Brennan, Royal Army Medical Corps (Special Reserve).

Capt. George Crawshaw, M.B., Royal Army Medical Corps.

Temp. Capt. Douglas Erith Derry, Royal Army Medical Corps.

Temp. Capt. Thomas Duncan, Royal Army Medical Corps.

Capt. Fred Ellis, Royal Army Medical Corps.

Temp. Capt. Andrew Gaston, Royal Army Medical Corps.

Capt. William Evans Graham, M.B., Royal Army Medical Corps.

Temp. Capt. John Lewis Anderton Grout, Royal Army Medical Corps.

Lieut. Henry John Henderson, M.B., Royal Army Medical Corps.

Capt. Charles Edward Kynaston Herapath, Royal Army Medical Corps.
Capt. David Mackie, M.B., Royal Army Medical Corps (Special Reserve).
Temp. Capt. John Charsley Mackwood, Royal Army Medical Corps.
Temp. Capt. William Stretley Martin, M.B., Royal Army Medical Corps.
Temp. Capt. John Louis Menzies, M.B., Royal Army Medical Corps.
Temp. Capt. James Betram Mitton, M.B., Royal Army Medical Corps.
Temp. Capt. John Henry Morris-Jones, Royal Army Medical Corps.
Temp. Capt. Joseph Herbert Porter, M.B., Royal Army Medical Corps.
Temp. Capt. Norman Pallister Pritchard, Royal Army Medical Corps.
Capt. James Purdie, Royal Army Medical Corps (Special Reserve).
Capt. James Rafter, M.B., Royal Army Medical Corps (Special Reserve).
Temp. Capt. Alan Randle, M.D., Royal Army Medical Corps.
Capt. Hugh Arthur Sandiford, M.B., Royal Army Medical Corps.
Temp. Capt. William Logan Scott, M.B., Royal Army Medical Corps.
Capt. Frederic Battinson Smith, Royal Army Medical Corps.
Capt. Edwin Cyril Widmerpoole Starling, Royal Army Medical Corps (Special Reserve).
Temp. Capt. John Glyndor Treharne Thomas, Royal Army Medical Corps.
Temp. Capt. John Aylmer Tippett, Royal Army Medical Corps.
Capt. Adam Annand Turner, M.B., Royal Army Medical Corps.
Temp. Capt. John Wilfred Watthews, M.B., Royal Army Medical Corps.
Capt. Harry Whitaker, M.B., Royal Army Medical Corps.
Temp. Capt. Henry Dewi Hampton Willis-Bund, Royal Army Medical Corps.

Australian Imperial Force.

Capt. Douglas Lewis Barlow, Army Medical Corps.
Capt. John Herald Balfour Brown, Army Medical Corps.
Capt. Arthur Curtis, Army Medical Corps.
Capt. Stuart Galloway Gibson, Army Medical Corps.
Capt. Stanley Arthur Railton, Army Medical Corps.
Capt. Eric William Beresford Woods, Army Medical Corps.

New Zealand Force.

Capt. William Norman Abbott, Army Medical Corps.
Capt. Frederick William Kemp, Army Medical Corps.

South African Force.

Capt. Edmund Lewis Reid, Medical Corps.

His Majesty the King has been graciously pleased to approve of the award of the Distinguished Conduct Medal to the undermentioned Non-Commissioned Officer and Men for acts of gallantry and devotion to duty in the Field :—

No. 2245 Serjt. A. Gripps, Royal Army Medical Corps (S. Acton, W.).
No. 46707 Pte. (Acting Serjt.) J. E. Davies, Royal Army Medical Corps (Wombwell).
No. 62146 Pte. (Acting Serjt.) W. Jordan, Royal Army Medical Corps (Dunston).
No. 20117 Pte. W. H. Millard, Royal Army Medical Corps (Tredegar).
No. 6650 Pte. J. Sharp, Royal Army Medical Corps (Leicester).
No. 66599 Pte. (Acting Lance-Serjt.) W. Smith, Royal Army Medical Corps (W. Lavington).
6434 Pte. (Acting Lance-Serjt) T. Waterman, Royal Army Medical Corps (Gillingham).

War Office,
November 28, 1917.

The Secretary of State for War has received the following dispatch from Lieut.-Gen. G. F. Milne, C.B., D.S.O., Commanding in Chief, British Salonika Force :—

General Headquarters,
British Salonika Force,
October 25, 1917.

My Lord,—I have the honour to submit herewith a list of names of the Officers, Warrant Officers, Non-commissioned Officers, Men and Nursing Staff, whose services

I desire to bring to your Lordship's notice for gallant conduct and distinguished services rendered during the past six months.

I have the honour to be, my Lord,
Your Lordship's most obedient servant,
G. F. MILNE, *Lieutenant-General,*
Commanding in Chief, British
Salonika Force.

Lieut.-Col. (Acting Col.) A. R. Aldridge, C.S.I., C.M.G., M.B., Royal Army Medical Corps, Reserve of Officers.
Lieut.-Col. E. T. F. Birrell, C.B., C.M.G., M.B., Royal Army Medical Corps.
Lieut.-Col. H. J. M. Buist, D.S.O., M.B., Royal Army Medical Corps.
Major P. G. Easton, D.S.O., Royal Army Medical Corps.
Capt. W. R. Galwey, M.C., Royal Army Medical Corps.
Lieut.-Col. J. E. Hodgson, Royal Army Medical Corps.
Col. M. P. C. Holt, K.C.M.G., C.B., D.S.O., Army Medical Service.
Major J. T. Johnson, D.S.O., M.D., Royal Army Medical Corps.
Capt. N. V. Lothian, M.B., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) W. H. S. Nickerson, V.C., C.M.G., M.B., Royal Army Medical Corps.
Lieut.-Col. (Temp. Col.) F. S. Penny, C.M.G., M.B., Royal Army Medical Corps.
Col. G. T. Rawnsley, C.M.G., Army Medical Service.
Lieut.-Col. and Brevet-Col. (Temp. Col.) F. Smith, C.M.G., D.S.O., Royal Army Medical Corps.
Temp. Lieut.-Col. E. H. Starling, M.D., F.R.C.P., F.R.S., Royal Army Medical Corps.
Capt. M. J. Williamson, M.C., M.B., Royal Army Medical Corps.

ROYAL ARMY MEDICAL CORPS.

Temp. Capt. D. I. Anderson, M.B.
Temp. Qmr. and Hon. Lieut. H. J. Angell.
Lieut.-Col. F. Ashe.
Temp. Capt. R. D. Attwood.
Temp. Capt. J. Bain, M.B.
Qmr. and Hon. Lieut. J. Banks.
Lieut. (Temp. Capt.) D. W. Beamish.
Temp. Capt. A. Benjamin, M.B.
Temp. Capt. W. H. Brodie, M.B.
Temp. Capt. M. S. Bryce, M.C., M.B.
Temp. Capt. (Acting Lieut.-Col.) C. V. Bulstrode (Major R.H.A.).
Temp. Capt. G. B. Buswell, M.C., M.B.
Temp. Capt. L. Cassidy, M.B., F.R.C.S.I.
Capt. W. F. Christie, M.B.
Qmr. and Hon. Lieut. W. Clegg.
Temp. Capt. A. H. Coleman, M.B.
Temp. Qmr. and Hon. Lieut. J. Cotter.
Temp. Capt. P. C. Davie, M.B.
Temp. Capt. J. N. Dobbie, M.B.
Temp. Lieut.-Col. L. S. Dudgeon, F.R.C.P.
Temp. Capt. H. H. L. Ellison.
Temp. Capt. R. R. Elworthy, M.D.
Temp. Capt. H. R. Evans, M.D.
Temp. Capt. D. Fettes, M.B.
Temp. Capt. W. H. Fleetwood.
Temp. Capt. J. G. Forbes, M.D.
Temp. Capt. A. R. Green, M.B.
Temp. Capt. C. S. Van R. Harwood, M.B.
Temp. Capt. J. F. C. Haslam, M.B.
Capt. J. R. Hill, M.B.
Temp. Capt. J. F. Hoare.
Temp. Capt. H. G. Hobson,
Temp. Qmr. and Hon. Lieut. A. Jackson.
Capt. and Brevet-Major (Acting Lieut.-Col.) B. Johnson, M.B.
Temp. Capt. J. M. Kelly, M.D.
Temp. Capt. A. A. Lees.

Lieut. (Temp. Capt.) A. M. McCutcheon, M.B.
Capt. A. C. Macdonald, Special Reserve.
Temp. Capt. W. K. McIntyre, M.B.
Lieut.-Col. C. B. Martin, M.B.
Temp. Capt. H. H. Moffatt.
Temp. Capt. H. G. Murray, M.B.
Temp. Capt. D. R. E. Roberts, M.B.
Temp. Capt. J. A. Sloan, A.S.C.
Lieut.-Col. L. F. Smith, C.M.G., M.B.
Temp. Major J. W. Struthers, M.B., F.R.C.S.Edin.
Capt. (Acting Lieut.-Col.) P. S. Tomlinson.
Temp. Capt. J. D. Watson, M.B.
Temp. Capt. T. B. Williams, M.B.
Temp. Capt. D. E. S. Wishart, M.B.
Lieut.-Col. S. H. Withers, C.M.G., M.B.
No. 57440 Pte. C. Allen.
No. 3740 Pte. (Acting Lance-Cpl.) T. Allan.
No. 33602 Staff-Serjt. H. C. Andrews.
No 83992 Pte. (Acting Serjt.) G. Avery.
No. 100233 Pte. (Acting Lance-Cpl.) G. Barras.
No. 63372 Cpl. (Acting Serjt.) W. E. Beasley.
No. 62206 Cpl. (Acting Serjt.) W. J. Bedwell.
No. 16481 Staff-Serjt. (Acting Qmr.-Serjt.) W. W. Bee.
No. 12495 Serjt.-Major T. H. Brewer.
No. 36977 Serjt.-Major G. L. Brown.
No. 64333 Serjt. R. Carlisle.
No. 39661 Serjt.-Major T. Davey.
No. 52614 Serjt. (Acting Qmr.-Serjt.) W. Dover.
No. 49823 Staff-Serjt. (Acting Qmr.-Serjt.) R. Dunn.
No. 24308 Cpl. C. Edwards.
No. 21061 Cpl. (Acting Serjt.) E. F. Fincham.
No. 31235 Serjt. (Acting Serjt.-Major) A. Goodwin.
No. 8719 Pte. (Acting Lance-Cpl.) F. H. Grainger.
No. 26710 Serjt. (Acting Staff-Serjt.) P. Griffiths.
No. 53742 Pte. (Acting Cpl.) E. Henshall.
No. 42722 Serjt.-Major S. Jacob.
No. 23550 Qmr.-Serjt. A. Keen.
No. 26639 Qmr.-Serjt. (Acting Serjt.-Major) T. Liddell.
No. 32831 Cpl. A. S. Lidington.
No. 26422 Qmr.-Serjt. E. J. Maiden.
No. 2157 Serjt. (Acting Serjt.-Major) C. W. Newell.
No. 47352 Staff-Serjt. (Acting Qmr.-Serjt.) A. Newton.
No. 29819 Pte. R. W. Nixon.
No. 57509 Pte. M. O'Brien.
No. 26735 Staff-Serjt. (Acting Serjt.-Major) W. Otterson.
No. 32861 Staff-Serjt. W. L. Owen.
No. 46943 Pte. (Acting Cpl.) F. W. Pentland.
No. 113 Serjt. (Acting Serjt.-Major) J. D. Powell.
No. 24355 Serjt. (Acting Staff-Serjt.) D. S. Roberts.
No. 1715 Serjt. (Acting Staff-Serjt.) H. G. Rogers.
No. 9548 Serjt. H. O. Rothry.
No. 2218 Pte. G. Snape.
No. 68971 Pte. (Acting Cpl.) J. W. Straw.
No. 1866 Serjt. W. Sugden.
No. 26349 Serjt.-Major F. Sutcliffe.
No. 10425 Staff-Serjt. (Acting Qmr.-Serjt.) A. Tollafield.
No. 24546 Regtl. Serjt.-Major T. Vincent.
No. 2235 Staff-Serjt. T. Walkley.
No. 25165 Cpl. (Acting Serjt.) T. Willett.
Capt. R. D. Cameron, M.B.
Capt. I. D. Dickson, M.D.
Lieut. W. Donald, M.B.
Capt. W. B. Foley, M.B.
Capt. N. H. Harrison.
Capt. G. F. V. Leary, M.B.

Capt. W. A. Lethem, M.B.
Capt. N. L. Lochrane, M.B.
Capt. O. J. O'B. O'Hanlon, M.B., F.R.C.S.
Capt. L. J. Sheil, M.D.
Capt. E. A. Wilson, M.B.
Capt. A. E. Barnes, M.B.
Capt. G. B. Brand, M.B.
Capt. T. Carnwath, M.B. (Special Reserve).
Capt. W. K. Churchouse.
Capt. (Temp. Major) G. H. Colt, M.B., F.R.C.S.
Qrm. and Hon. Lieut. J. W. Corking.
Capt. E. H. Coyne, M.B.
Capt. B. L. Davis.
Capt. T. C. English, C.M.G., M.B., F.R.C.S. (Temp. Col. Army Medical Service).
Capt. H. A. T. Fairbank, F.R.C.S.
Capt. (Temp. Major) A. W. Falconer, M.B.
Major (Acting Lieut.-Col.) D. L. Fisher, M.B.
Capt. E. G. Gauntlett, M.B., F.R.C.S.
Capt. J. F. Gaskell, M.D.
Major (Temp. Lieut.-Col.) J. Gray.
Capt. A. D. Griffith, M.D., F.R.C.S.
Capt. A. W. Harrington, M.D.
Capt. H. S. Hollis, M.B.
Capt. B. Hughes, M.B., F.R.C.S., W. York Regiment.
Capt. R. E. Kelly, M.D., F.R.C.S.
Qmr. and Hon. Capt. (Temp. Lieut.-Col.) J. Keogh.
Major (Temp. Lieut.-Col.) A. E. Kidd, M.B.
Capt. D. Mallam.
Capt. W. J. F. Mayne, M.B.
Capt. P. H. Mitchiner, M.B., F.R.C.S.,
Capt. (Temp. Major) K. W. Monsarrat, M.B., F.R.C.S.
Capt. A. Oliver, M.D.
Capt. J. P. Stewart, C.B., M.D., F.R.C.P. (Temp. Col. Army Medical Service).
Capt. R. M. Vick.
Major E. B. Waggett, M.B.
Major (Acting Lieut.-Col.) J. Ward.
No. 510117 Pte. (Acting Cpl.) P. J. Barraud.
No. 533032 Pte. (Acting Cpl.) R. C. Brischlayer.
No. 527026 Lance-Cpl. W. E. Bruce.
No. 546074 Staff-Serjt. T. A. Cartledge.
No. 527441 Pte. W. T. Clarke.
No. 497215 Pte. (Acting Lance-Cpl.) E. C. Dolton.
No. 546094 Serjt. W. H. Draper.
No. 390001 Qmr.-Serjt. (Acting Serjt.-Major) R. W. Edwards.
No. 527153 Staff-Serjt. C. Firth.
No. 493007 Serjt. A. H. Holtum.
No. 536345 Pte. G. G. Horrocks.
No. 527253 Pte. (Acting Serjt.) W. R. Jackson.
No. 527015 Staff-Serjt. H. M. Lion.
No. 92776 Cpl. B. G. Manning.
No. 510257 Pte. F. Panichelli.
No. 512005 Serjt. G. R. Prior.
No. 534339 Cpl. E. S. Radmore.
No. 10425 Staff-Serjt. (Acting Qmr.-Serjt.) A. Tollafield.
No. 545681 Pte. (Acting Lce.-Cpl.) B. H. Toms.
No. 24546 Regtl. Serjt.-Major T. Vincent.
No. 2235 Serjt. (Acting Staff-Serjt.) T. Walkley.
No. 25165 Cpl. (Acting Serjt.) T. Willett.

MEDICAL WOMEN (ATTACHED ROYAL ARMY MEDICAL CORPS).

Miss Mary Alice Blair.
Miss Barbara Martin Cunningham.
Miss Elsie Jean Dalyell.
Miss Elizabeth Mary Edwards.
Miss Edith Blake Hollway.

ARMY MEDICAL SERVICE.

Col. Foster R. Newland, C.M.G., M.B., to be Temp. Surg.-Gen., dated November 17, 1917.

Col. (Temp. Surg.-Gen.) Henry Neville Thompson, C.M.G., D.S.O., M.B., on completion of four years in his rank, is retained on the Active List, under the provisions of Arts. 120 and 522 R. Warrant for Pay and Promotion, dated November 17, 1917.

ROYAL ARMY MEDICAL CORPS.

Major Thomas B. Moriarty, to be Acting Lieut.-Col. whilst in command of a Medical Unit, dated July 3, 1917. (Substituted for the notification in the *Gazette* of October 2, 1917.)

Major Joseph F. Whelan, M.B., to be Acting Lieut.-Col. whilst in command of a Medical Unit, dated September 13, 1917.

Lieut.-Col. Arthur R. Aldridge, C.S.I., C.M.G., M.B., relinquishes the acting rank of Colonel on re-posting, dated October 18, 1917.

Major Edward L. Moss, M.C., to be Acting Lieut.-Col., whilst in command of a Medical Unit, dated November 6, 1917.

The undermentioned Majors relinquish the rank of Temp. Lieut.-Col. on ceasing to command a Training Centre:—

Dated October 26, 1917.—(Brevet Lieut.-Col.) Barry A. Craig; Alastair N. Fraser, D.S.O., M.B.

The undermentioned to be Acting Lieut.-Cols. whilst in command of a Medical Unit:—

Dated August 9, 1917.—Temp. Capt. Albert Jones, M.C., M.D.

Dated October 7, 1917.—Major Richard N. Woodley, D.S.O.

Lieut.-Col. Arthur W. N. Bowen, D.S.O., relinquishes the rank of Temp. Col. on re-posting, dated June 29, 1917.

Lieut.-Col. Samuel A. Archer, to be Temp. Col. whilst employed as Asst. Dir. of Medical Services of a Division, dated October 28, 1917.

Major Philip J. Marett relinquishes the rank of Temp. Lieut.-Col. on re-posting, dated July 8, 1917.

Major Philip J. Marett to be Acting Lieut.-Col. whilst in command of a Medical Unit, dated October 9, 1917.

Major Walter A. S. J. Graham is seconded for employment under the Ministry of National Service, dated November 1, 1917.

ROYAL ARMY MEDICAL CORPS FUND.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT THE WAR OFFICE, ADASTRAL HOUSE, ON TUESDAY, OCTOBER 2, AT 3.15 P.M.

Present:

Surg.-Gen. M. W. Russell, C.B. in the Chair.
Col. Sir J. Magill, K.C.B.
Col. C. R. Tyrrell, C.B.
Lieut.-Col. A. B. Cottell.
Lieut.-Col. Sir E. S. Worthington, C.M.G., M.V.O.
Capt. F. R. Laing.

(1) The Minutes of the last meeting held on July 10 were read and confirmed.

(2) Col. Sir J. Magill and Lieut.-Col. A. B. Cottell, took their seats on appointment as members of the Committee.

(3) The Secretary brought to notice the present constitution of the Committee as reconstructed by the meeting held on April 18, 1910, and it was proposed by Col. C. R. Tyrrell, and seconded by Col. Sir J. Magill, "that the constitution of the Committee should be amended by the inclusion of the Trustees as members ex-officio and the reduction of the Retired Pay Officers from four to three at the next vacancy." Subject to confirmation by the next Annual General Meeting.

Also that the Officer Commanding the Depot at Blackpool be asked to nominate a junior officer at Aldershot.

(4) The Secretary reported the purchase of additional War Loan 5 per cent stock to make up the holding by the Royal Army Medical Corps Fund to an even amount.

(5) The Secretary read correspondence with Messrs. Evan, Pierson and Co., and it

was decided to request them to undertake the auditorship of the Royal Army Medical Corps General Relief and School Funds for the present year at the terms proposed.

(6) The question of separating the accounts of (1) the Royal Army Medical Corps Fund, and (2) of the General Relief and School Funds was considered, and the alteration approved.

The Secretary read correspondence with the Public Trustee and also with Messrs. Holt and Co. regarding the Trusteeship of the Investments of the Royal Army Medical Corps Fund, and it was resolved to ask Messrs. Holt and Co. to draft a Resolution empowering the existing Trustees of the Investments of the General Relief Fund to deal with the Investments of the Royal Army Medical Corps Fund, and to open separate A and B accounts with the Bank of England in respect of the War Loans, etc., where both Funds are holders.

The Committee further authorized the Chairman to sign such Resolution if approved on their behalf to obviate the necessity of waiting until the next Committee Meeting in January, 1918.

(8) The Secretary reported the present position as regards children being educated by the Compassionate School Fund, and it was decided to give donations to the Drummond Institute, and School for destitute Catholic children.

(9) The Secretary reported two grants of £4 each from the General Relief Fund to urgent cases.

These were approved and a grant of £6 was also authorized to the widow and three children of a N.C.O. of the Corps who are resident at Gibraltar.

(10) The Secretary reported that seventeen new members had joined since the last meeting as a result of notices sent to all young officers recently appointed to permanent commissions, and also gave particulars of the present cash balance of the three Funds.

It was resolved to invest £700 from the General Relief Fund in the new National War Bonds 5 per cent. The series to be selected after consultation with Messrs. Holt and Co.

(11) An application for assistance by the Hon. Secretary of the Royal Army Medical Corps Comforts Fund was considered, and it was proposed by Col. C. R. Tyrrell and seconded by Sir J. Magill that a grant of £25 should be made from the Relief Fund.

An application was also considered from the Hon. Secretary of the Army and Navy Male Nurses Corporation for an additional grant from the General Relief Fund on account of the exceptional difficulties in carrying on the Institution in consequence of the War. It was proposed by Lieut.-Col. A. B. Cottell and seconded by Lieut.-Col. Sir E. S. Worthington that a grant of £20 should be made as a special case.

The Secretary read correspondence with the County Fire Office, regarding the insurance of the office furniture, books, etc., against aircraft, and it was decided to effect a policy for £200 at a premium of 2s.

Capt. J. R. Laing, Band President of the Royal Army Medical Corps depot, Blackpool, submitted and explained the band accounts for the period, April 1, to September 19. These were considered and approved, and directed to be published in Corps News. A copy is attached to these Proceedings.

It was noted that no further grant is required from the Royal Army Medical Corps Fund at present.

AUXILIARY ROYAL ARMY MEDICAL CORPS FUNDS.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT ADASTRAL HOUSE, WAR OFFICE, ON TUESDAY, OCTOBER 2, AT 3.15 P.M.

Present:

Surg.-Gen. M. W. Russell, C.B., in the chair.
Col. Sir J. Magill, K.C.B.
Col. C. R. Tyrrell, C.B.
Lieut.-Col. A. B. Cottell.
Lieut.-Col. Sir E. S. Worthington, C.M.G., M.V.O.
Capt. F. R. Laing.

(1) The Minutes of the last meeting held on July 10 were read and confirmed.

(2) Col. Sir J. Magill and Lieut.-Col. A. B. Cottell took their seats on appointment as members of the Committee.

(3) The Secretary brought to notice the present constitution of the Committee as reconstructed by the meeting held on April 18, 1910, and it was proposed by Col. C. R. Tyrrell, and seconded by Col. Sir J. Magill, "that the constitution of the Committee should be amended by the inclusion of the Trustees as members ex-officio and the reduction of the Retired Pay Officers from four to three at the next vacancy," subject to confirmation by the next Annual General Meeting. Also that the Officer Commanding the depot at Blackpool be asked to nominate a junior officer at Aldershot.

(4) The Secretary reported the purchase of additional War Loan five per cent stock to make up the holding by the R.A.M.C. Fund to an even amount.

(5) The Secretary read correspondence with Messrs. Evans, Pierson and Co., and it was decided to request them to undertake the auditorship of the R.A.M.C. General Relief and School Funds for the present year at the terms proposed.

(6) The question of separating the accounts of (1) the R.A.M.C. Fund and (2) of the General Relief and School Funds was considered and the alteration approved.

(7) The Secretary read correspondence with the Public Trustee and also with Messrs. Holt and Co., regarding the trusteeship of the investments of the R.A.M.C. Fund, and it was resolved to ask Messrs. Holt and Co. to draft a resolution empowering the existing Trustees of the investments of the General Relief Fund to deal with the investments of the R.A.M.C. Fund, and to open separate A and B accounts with the Bank of England in respect of the War Loans, &c., where both Funds are holders. The Committee further authorized the Chairman to sign such resolution, if approved, on their behalf to obviate the necessity of waiting until the next Committee Meeting in January, 1918.

(8) The Secretary reported the present position as regards children being educated by the Compassionate School Fund, and it was decided to give donations to the Drummond Institute and School for Destitute Catholic Children.

(9) The Secretary reported two grants of £4 each from the General Relief Fund to urgent cases. These were approved, and a grant of £6 was also authorized to the widow and three children of a N.C.O. of the Corps who are residing at Gibraltar.

(10) The Secretary reported that seventeen new members had joined since the last meeting as a result of notices sent to all young officers recently appointed to permanent commissions, and also gave particulars of the present cash balances of the three Funds.

It was resolved to invest £700 from the General Relief Fund in the new National War Bonds 5 per cent, the series to be selected after consultation with Messrs. Holt and Company.

(11) An application for assistance by the Hon. Secretary of the Royal Army Medical Corps Comforts Fund was considered, and it was proposed by Col. C. R. Tyrrell, and seconded by Sir J. Magill, that a grant of £25 should be made from the General Relief Fund.

(12) An application was also considered from the Hon. Secretary of the Army and Navy Male Nurses Co-operation for an additional grant from the General Relief Fund on account of the exceptional difficulties in carrying on the institution in consequence of the War. It was proposed by Lieut.-Col. A. B. Cottell, and seconded by Lieut.-Col. Sir E. S. Worthington, that a grant of £20 should be made as a special case.

(13) The Secretary read correspondence with the County Fire Office regarding the insurance of the office furniture, books, &c., against aircraft, and it was decided to effect a policy for £200 at a premium of 2s.

Captain J. R. Laing, Band President of the Royal Army Medical Corps Depot, Blackpool, submitted and explained the Band Accounts for the period April 1 to September 19. These were considered and approved, and directed to be published in "Corps News." A copy is attached to these Proceedings.

It was noted that no further grant is required from the Royal Army Medical Corps Fund at present.

AUXILIARY ROYAL ARMY MEDICAL CORPS FUNDS.

Report of the General Annual Meeting of the Auxiliary Royal Army Medical Corps Funds, held at the Royal Medical College, Grosvenor Road, S.W., on Friday, October 26, 1917, Lieutenant-Colonel Sir Alfred Pearce Gould, one of the Vice-Presidents, presiding in the absence of Surgeon General Sir Alfred Keogh, G.C.B., Director General, Army Medical Service.

The Chairman : I would like to say that this is practically the first annual meeting of the Auxiliary Royal Army Medical Corps Funds, and I will therefore ask Lieut.-Col. Wilson to read the Report of the Committee for the year 1916.

The Secretary, Lieut.-Col. E. M. Wilson, then read the report, which was carried. The accounts for 1916 were also considered and passed.

The Secretary then read the report of the Committee for the year 1917, up to September 30, as follows :—

DRAFT REPORT FOR THE ANNUAL GENERAL MEETING, OCTOBER 26.

The Committee in presenting their Annual Report for the year 1917 and Statement of Accounts draw attention to the fact that the latter are only made up for the period ending December 31, 1916. They have therefore prepared for the information of the general body of the subscribers a further brief statement showing the receipts and expenditure up to September 30. By this it will appear that for the

Benevolent Branch

the total so far received for subscriptions amounts to £960 0s. 6d. against £796 13s. 6d. for six months of 1916, and from donations to £1,112 8s. 1d. against £1,435 16s. 11d. for last year.

The number of subscribers is 620 against 503, and nearly 100 more have already joined this month in consequence of the President's personal appeal letter.

This shows a steady increase in the membership of the Fund, but the Committee desire to impress particularly on all subscribers the necessity of largely increasing the membership in the forthcoming year. They are strongly of opinion that a great deal can be done by individual appeals of the present members to brother officers together with explanations of the scope and purpose of the Funds. Large numbers of circulars have been issued, but it is believed that personal efforts on the part of the members and also of Presidents of Mess Committees are likely to prove far more efficacious. This is also true with regard to the bringing to the notice of the Committee cases of orphans of deceased officers deserving of assistance.

The cases which have been reported are being dealt with by the General Annual Meeting. but there are probably others within the knowledge of members which could be investigated if they are reported. The expenditure from this Branch has been small and in consequence it has been found possible to invest £3,800 in the New War Loan at 5 per cent.

Relief Branch.

The grants from Royal Army Medical Corps Units have amounted so far to nearly £2,000, and as the cases of distress among widows and orphans of deceased soldiers brought to notice have been very few a very large proportion has been invested in the 5 per cent. War Loan for future needs. The total amount thus invested for this branch is now £4,400. It is suggested that officers commanding units at home and abroad who know anything of the circumstances in which the widows and orphans of deceased soldiers of their units are left, should report cases deserving of assistance to the Secretary in order that inquiries may be made without delay.

The Committee desire to bring before the general body of subscribers their appreciation of the services of the late Secretary, Lieut.-Col. F. W. H. Davie-Harris, who gave most valuable assistance in the formation of the Funds and worked energetically in the interests of the Charity until his death in June, 1917.

It is recommended that as from January 1, 1918, an Honorary Secretary shall be appointed and that the Funds shall bear the cost of stationery, postage, and clerical expenses.

The Committee submit a resolution relating to the grant of assistance from the Benevolent Branch to the orphans of officers in urgent cases as follows :—

Resolved in order that relief from the Benevolent Branch to orphans of officers may be granted in urgent cases more frequently than once a year at the Annual

General Meeting, that Rule 20 may be amended by the addition of the following words at the end of the rule: "Or in special cases by the Committee provided that no grant for any one case shall exceed £20 before the next General Meeting of subscribers (see Rule 5). The necessary alterations to be made in other rules to admit of this being done."

It is proposed by the Committee that Rule 1 may be altered so as to allow of assistance being given to the children of officers who are totally disabled as well as to orphans.

Proposed by the Committee that Rule 7 of the Relief Branch may be altered to allow of the maximum grant being raised to £10 instead of £5 as at present.

Sir A. Pearce Gould: May I put the report for the year 1917 before the meeting? Those in favour? Carried.

RESOLUTIONS.

The first resolution that an Honorary Secretary be appointed from January 1, 1918, and that the offer of Lieut.-Col. W. Hale White to undertake the duties be gratefully accepted. Also that Lieut.-Col. C. W. Mansell Moullin be appointed Honorary Treasurer. Agreed.

The second is, to give the Committee power to deal with special cases with permission to make a grant not exceeding £20 in any one case before the annual meeting. You must give the Committee power to deal with these cases. Agreed.

The third suggestion is, that the Committee should alter Rule 1 so as to allow of assistance being given to the children of officers who are totally disabled. This is a very valuable extension of the Benevolent Section. Agreed.

The fourth is, that it is proposed that Rule 7 of the Relief Branch may be altered so as to allow a maximum grant of £10 instead of £5. Agreed.

Recommendations by the Committee for grants from the Benevolent Branch were considered, and it was decided to distribute £160 among the orphans of six deceased officers (list attached). One case was deferred for future consideration.

It was proposed by Major Newton Pitt and seconded by Capt. Johnson that the grants be paid by three instalments according to the discretion of the Committee. Approved.

ELECTION OF OFFICERS. Proposed by Sir A. Pearce Gould and seconded by Major Maclean that Sir A. Keogh be re-elected President. Agreed.

It was proposed, seconded and carried that the following be re-elected Vice-Presidents: Surg.-Gen. Sir A. Bowlby, K.C.M.G., C.B., Lieut.-Col. Sir A. Pearce Gould, K.C.V.O., Surg.-Gen. Sir G. H. Makins, K.C.M.G., C.B., Lieut.-Col. Sir B. E. Moynham, C.B., Col. Sir F. Treves, Bt., G.C.V.O., and Sir Almroth Wright, C.B., F.R.S. Trustees: Lieut.-Col. Sir W. Watson Cheyne, Bt., C.B., Lieut.-Col. Sir W. Osler, Bt., and Vesey Holt, Esq. Auditors: Messrs. Evans, Pierson and Co.

Major Maclean: It is open for the meeting to propose that any member of the Committee be replaced or the whole be replaced. It is quite clear that we have not on our Committee an officer belonging to the New Armies.

Proposed by Major Greenhill and seconded by Major Farquharson that Major Davies, Colchester, and Major E. H. T. Nash, Lord Derby War Hospital, be appointed as members of the Committee in place of Lieut.-Col. Mansell Moullin, appointed Honorary Treasurer, and Lieut.-Col. W. Hale White, appointed Honorary Secretary. This was carried. The remainder of the Committee were re-elected.

A vote of thanks was passed to Sir A. Pearce Gould for presiding and also to the Secretary, Lieut.-Col. E. M. Wilson, C.B., C.M.G., D.S.O.

REPORT OF THE COMMITTEE OF THE ABOVE FUNDS FOR THE YEAR 1916.

Though a preliminary meeting of officers of the Auxiliary R.A.M.C. Forces was held at the instigation of Surg.-Gen. Sir Alfred Keogh, G.C.B., on June 1, and a scheme was drawn up by a Provisional Committee, it was not until August 7 that it was decided by the vote of a very large majority of Auxiliary Officers to adopt the proposed scheme and to start the Funds.

It was resolved by the Committee that no distribution from the Funds for cases of relief or distress should be given during the remaining months of 1916.

As the Funds on December 31, 1916, were established on a sound financial basis, the Committee are now in a position to receive application for grants for consideration, and will be glad to hear of deserving cases of distress, either for the Officers' Benevolent or the Relief Branch.

The total receipts for 1916 were £2,343 0s. 5d., and the expenditure amounted to £247 11s. 10d., a large moiety of which was expended on preliminary expenses and which will not recur.

The Committee sent out 12,000 letters of invitation to officers to become subscribers. As it was impossible to obtain the address of each individual officer, a large number of these letters were sent to D.D.M.S. of districts or divisions with a covering letter from Surg.-Gen. Sir Alfred Keogh, asking them kindly to assist in their distribution to the officers under their command.

Relief Branch.

The receipts amounted to £2,745 3s. 2d., and the expenditure, which was entirely banker's charges, to £2 2s. 2d.

A letter, asking for grants, from the Regimental Institutes was sent to every R.A.M.C. Unit, both at home and abroad. Owing to the institution of the Field Force Canteen in France, many units have ceased to run institutes on their own account.

The Committee have had a Trust Deed drawn up in the names of Lieut.-Col. Sir William Watson Cheyne, Bt., Lieut.-Col. Sir William Osler, Bt., and Vesey Holt, Esq., who have kindly consented to become Trustees to the Fund.

It will be noticed that the Officers' Benevolent Branch has borne all the preliminary, administrative, and working charges. The Committee proposed to bring the matter before the next Annual General Meeting to decide what proportion of such expenses shall be allocated to the Relief Branch.

Benevolent Branch.

List of orphans of deceased officers to whom grants were made at the Annual General Meeting, held on October 26, 1917.

3 orphans	of	Captain H. F. C. N.	£40	0	0
4	,,	Major E. B.	40	0	0
1	,,	Lieut. J. N.	20	0	0
2	,,	Capt. H. G. M.	40	0	0
2	,,	Capt. A. G.	25	0	0
2	,,	Lieut. A. K. A.	15	0	0
			£160	0	0

Proceedings of a Committee Meeting held at the Royal Army Medical College, Grosvenor Road, on October 26, at 11 a.m.

Present:

Major Ewen J. Maclean (Chairman).
Major A. C. Farquharson.
Lieut.-Col. C. W. Mansell Moullin.
Capt. R. J. Stirling.
Major D. W. Patterson.
Lieut.-Col. W. Collier.
Lieut.-Col. W. Hale White.
Major G. Newton Pitt.

(1) The proceedings of the Committee Meeting held on July 19 were read and confirmed.

(2) The recommendation of a sub-committee held on August 17 appointed by paragraph 12 of the meeting held on July 19 were read and approved, and it was decided to recommend to the General Annual Meeting that an Honorary Secretary shall be appointed as from January 1, 1918, the expenses of postage, stationery, &c., to be borne by the funds; and that the kind offer of Lieut.-Col. W. Hale White to undertake the duties should be gratefully accepted.

(3) The proceedings of a special committee meeting held on August 17 were read and approved, and it was decided to recommend to the General Annual Meeting that Lieut.-Col. C. Mansell Moullin be appointed Honorary Treasurer.

(4) The draft for the Annual Report of the Committee was considered, amended, and adopted for presentation to the Annual General Meeting.

(5) The applications for assistance from the Benevolent Branch to orphans of deceased officers, seven in number, were considered, and recommendations as to grants by the General Meeting decided.

(6) A resolution empowering the Committee to grant assistance to orphans from the Benevolent Branch in cases of urgency was approved for submission to the Annual Meeting, and also a resolution modifying Rule 1 so as to admit of assistance being

granted to the children of officers totally incapacitated by wounds or disease contracted in the present War, as well as to orphans.

(7) Reports of grants made from the Relief Branch since the last meeting were received and approved, and it was decided to recommend to the General Annual Meeting that Rule 7 (Relief Branch) should be modified so as to admit of the maximum grant issuable to a widow or orphans of a Warrant or Non-commissioned Officer or man being raised to £10 in any one year instead of £5 as at present. The Secretary was also instructed to notify hospitals and other medical units of the existence of this Branch, and the desire of the Committee to grant assistance in deserving cases brought to their notice.

(8) The reports of donations of £3 3s. and upwards to the Benevolent Branch, and of grants to the Relief Branch for the quarter ending September 30 were received and ordered to be sent to the *Lancet*, *British Medical Journal*, and JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for publication.

(9) The question of the distribution of office and working expenses between the Benevolent and Relief Branches was considered, and it was decided that for the present the Benevolent Branch should continue to bear the whole cost. The matter to be reconsidered at a future date.

(10) The question of the investment of part of the balance in the current accounts of the two branches was referred to, and the Secretary was directed to take action after consultation with the Treasurer in accordance with paragraph 7 of the meeting dated July 19, 1917.

(11) A resolution was adopted for presentation to the Annual Meeting expressing the appreciation of the Committee for the services of the late Secretary, Lieut.-Col. F. W. H. Davie Harris, both in the formation of the Funds and subsequently up to the date of his death on June 20, 1917.

LIST OF DONATIONS OF £3 3s. AND UPWARDS RECEIVED FOR THE OFFICERS' BENEVOLENT BRANCH, FROM JULY 1 TO SEPTEMBER 30, 1917.

	£	s.	d.
Meat and Allied Trades Committee per Red Cross and Order of St. John	5	0	0
Royal Army Medical Corps Charities, Blackpool	20	0	0
Lieut.-Col. C. Mansell Moullin	5	5	0
Ninety Field Ambulance officers' donation	52	10	0
Capt. M. Dixon per Major Newton Pitt, 1,000 francs	36	4	8
Royal Army Medical Corps, Depôt, Blackpool, officers' donation	5	15	6
Capt. M. Dixon, 100 francs	3	12	1
M.H.G.F.	100	0	0
Col. D. Hepburn, C.M.G.	20	0	0
	£249	7	3

GRANTS RECEIVED FOR RELIEF BRANCH DURING THE QUARTER ENDING SEPTEMBER 30, 1917.

	£	s.	d.
Half of cheque from No. 2 Division, France	120	10	0
Lieut. J. Byrne	1	1	0
Capt. J. C. Neil	1	0	0
Regimental Institutes, R.A.M.C. Depot, Blackpool	500	0	0
No. 11 General Hospital	20	0	0
R.A.M.C. Companies, Egypt	3	0	0
No. 11 Field Ambulance, half of cheque to R.A.M.C. Fund	3	13	6
R.A.M.C. Charities, Blackpool	55	18	3
From R.A.M.C. Fund, half of cheque for 5,456 francs	100	0	0
No. 90 Field Ambulance	52	10	0
Codford Training Centre, Blackpool	5	5	8
43rd General Hospital, Salonika	50	0	0
J Corps Rest Station, France, 1916-17, per Col. Whaite	11	18	0
Queen Mary's Military Hospital, Whalley	50	0	0
No. 4 Stationary Hospital, part of cheque to R.A.M.C. Fund	11	0	0
No. 41 General Hospital, Salonika	27	0	0
No. 25 Motor Ambulance Convoy, per Capt. Stringer, 1,500 francs	54	10	10
	£1,067	7	3

ROYAL ARMY MEDICAL CORPS FUND—ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

LIEUT.-COL. E. M. WILSON, C.B. (*Late Royal Army Medical Corps*), *Secretary.*
124, *Victoria Street,*
November 16, 1917.

ROYAL ARMY MEDICAL CORPS COMFORTS.

DEAR SIR,—Will you kindly allow me to appeal through you to the readers of the CORPS NEWS for the support of the Royal Army Medical Comforts Fund. This Fund, which has been managed entirely by a Committee of Ladies of the Corps from almost the commencement of the War, provides comforts for the Warrant and N.C.O.'s and men on Active Service, but the Committee have always regarded men who are unfortunately prisoners of war as having the first claim. Parcels, and in some cases, small sums of money, are sent out regularly to these men through the recognized official channels and it is to avoid the possibility of these supplies ever falling short that the present appeal is now made. I feel sure that we only require the facts to become known to the Committees of Canteens and Regimental Institutes and to the officers of the Corps to prevent any anxiety on that account for the duration of the War. Several of the Regimental Institutes have already made handsome donations and others no doubt will be eager to devote some of their funds to the relief of their comrades who are in misfortune.

Cheques may be sent to Mrs. C. K. Morgan, Honorary Secretary,
Royal Army Medical College,
Grosvenor Road, S.W.

or to me, and will be gratefully acknowledged. It is hoped also to publish the accounts with names of subscribers in the Journal early next year as soon as they have been audited.

Yours very truly,
E. M. WILSON, *Lieut.-Col.,*
Hon. Treasurer.

The Editor, R.A.M.C. Journal,
War Office,
Adastral House.

ROYAL ARMY MEDICAL CORPS OFFICERS' BENEVOLENT SOCIETY.

PROCEEDINGS OF A COMMITTEE MEETING HELD AT THE WAR OFFICE, ADASTRAL HOUSE, ON OCTOBER 2, 1917, AT 2.30 P.M.

Present:

Surg.-Gen. M. W. Russell, C.B., Vice-President, in the Chair.
Surg.-Gen. Sir W. Donovan, K.C.B.
Col. H. W. Murray.
Lieut.-Col. A. B. Cottell.
Capt. J. T. Clapham.

(1) The Minutes of the last meeting held on July 10 were read and confirmed.

(2) Capt. J. T. Clapham took his seat as a member of the Committee.

(3) The Secretary reported purchase of additional stock, £39 3s. 6d. 5 per cent War Loan as directed by the last meeting.

(4) The Secretary reported that fourteen new members had joined since the last meeting as a result of notices sent out to recently appointed officers.

Also that the present cash balance standing to the credit of the Fund was £225 15s. 11d.

(5) The Secretary produced estimates of the cost of reprinting the Book of the Rules and List of Subscribers, and it was decided in view of the number of books still in stock to postpone action for the present.

(6) The Secretary reported the grant of £10 to an applicant under Rule 31, as an urgent case. Approved.

(7) Four other applications were submitted under Rule 24, considered by the Committee and small grants authorized.

(8) Capt. Clapham brought to notice a special donation of 250 rupees (£16 17s. 9d.) which has been received from the Rawal Pindi Officers' Mess, being money usually set aside for Christmas entertainment, but now presented to the Charity on account of the War, and it was decided to send a letter to the Mess Secretary expressing the cordial thanks of the Committee.

ROYAL ARMY MEDICAL CORPS CENTRAL MESS FUND.

SUMMARY OF THE PROCEEDINGS OF A MEETING OF THE COMMITTEE HELD AT THE WAR OFFICE ON NOVEMBER 14, 1917.

Present:

Major W. A. Ward, representing Aldershot, in the chair.
Major G. A. D. Harvey, C.M.G., representing Curragh.
Capt. H. G. Gibson, representing London.
Capt. H. S. Dickson, representing Woolwich.

(1) The minutes of the previous meeting were read and confirmed.

(2) Resolved that the charges for the current year, on account of fire, burglary, and air-craft insurances, payable by the London Mess, be met by the Central Fund; they amount to £38. Also that the Central Fund pay on behalf of this mess the annual charge of £41 4s. 6d. for the pension scheme for Brewer and Elliott for the current year.

(3) An application from the Royal Army Medical Corps Mess, Abbassia, for a grant of £40 for the purpose of making tennis courts was submitted. It was considered that such outlay did not come within the scope of the Fund.

(4) The Committee was informed that it was the wish of Lieut.-Col. Sir J. G. Rogers to present a collection of heads to the London Mess. As this mess is temporarily closed, and its bank balance is small, it was resolved that the hon. secretary of it be informed that the Central Fund was prepared to meet any reasonable charges for packing and freight of the collection from Egypt, where this might be found practicable.

(5) The Hon. Secretary reported to the Committee that he had sent individually notices of the objects of the Fund to all officers who had received permanent commissions in the Corps since the outbreak of war, and that up to the present eleven of those had become subscribers.

(6) Refund to the Hon. Secretary of £3 2s. 2d., expended by him in printing, postage, &c., was sanctioned.

Subscribers to the Fund are reminded that they are not liable for joining contributions (including those payable on promotion) to permanently established messes. These are paid by the Fund, and mess secretaries are asked to requisition for them quarterly.

3, *Homefield Road,*
Wimbledon, S.W. 19.

J. T. CLAPHAM, *Captain,*
Hon. Sec.

THE CENTRAL DEPOT, SURGICAL BRANCH OF QUEEN MARY'S NEEDLEWORK GUILD.

(SUPPORTED BY VOLUNTARY SUBSCRIPTIONS.)

President and Head of the Depot: H.R.H. PRINCESS BEATRICE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—Numerous cases that have come to my knowledge lead me to believe that many medical practitioners, matrons of hospitals and others concerned with the welfare and comfort of our soldiers and sailors who are suffering from wounds or sickness, are unaware of the work that is being done by the Central Depot of the Surgical Branch of Queen Mary's Needlework Guild.

One of the aims of this organization is to supply the ordinary dressings, appliances and comforts required for the troops at home and abroad, and efforts are made to arrange for the supply of any special bandages, splints and the like that a surgeon may have difficulty in procuring through the ordinary channels.

My object in writing this letter is to bring this institution and its work before the notice of the members of the medical profession, and to make it known as widely as possible that no legitimate application for assistance in the provision of surgical supplies is refused.

I am, Sir,
Yours faithfully,
MYRA A. GIBSON,
Honorary General Manager.

2, *Cavendish Square, W.* 1.
December 3, 1917.

BIRTH.

FFRENCH.—At Kelray, Ailesbury Park, Dublin, the wife of Major E. G. Ffrench, M.D., F.R.C.S.E., R.A.M.C., of son.

DEATH.

DICK.—On November 12, suddenly, Lieut.-Col. William Dick, M.B., F.R.C.S.E., R.A.M.C. (retired).

EXCHANGES, &c.

The charge for inserting Notices respecting Exchanges in the Royal Army Medical Corps is 5/- for not more than five lines, which should be forwarded by Cheque or P.O.O., with the notice, to Messrs. G. STREET and CO., Ltd., 8, *Serle Street, London, W.C., not later than the* 22*nd of the month.*

A free issue of twenty-five reprints will be made to contributors of Original Communications, and of twenty-five excerpts of Lectures, Travels and Proceedings of the United Services Medical Society.

Any demand for reprints, additional to the above, or for excerpts, must be forwarded at the time of submission of the article for publication, and will be charged for at the following rates, and additional copies at proportionate rates :—

Number of Reprints	Number of Pages	Cost of Reprints	Cost of Excerpts *	Extra for Covers for Reprints: As Journal, Printed on Front	Extra for Covers for Reprints: As Journal, Plain, Unprinted	Extra for Covers for Reprints: Cheaper Paper, Printed on Front	Extra for Covers for Reprints: Cheaper Paper, Plain, Unprinted
		£ s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.
	4	0 2 9	0 1 2				
12	8	0 5 0	0 2 8	4 3	1 1	3 10	0 9
	16	0 8 3	0 3 11				
	4	0 3 4	0 1 5				
25	8	0 6 0	0 2 9	4 10	1 6	4 4	0 11
	16	0 10 6	0 5 0				
	4	0 4 6	0 1 10				
50	8	0 7 6	0 3 6	6 0	2 1	4 10	1 2
	16	0 13 3	0 5 10				
	4	0 6 0	0 3 1				
100	8	0 10 0	0 4 10	7 10	3 11	6 7	2 5
	16	0 18 6	0 7 6				
	4	0 9 6	0 4 5				
200	8	0 15 0	0 6 7	10 10	7 6	9 0	4 10
	16	1 6 0	0 9 8				

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Notices.

EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc. He will also be glad to receive items of news and information regarding matters of interest to the Corps from the various garrisons, districts, and commands at home and abroad.

All such Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notified at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

Matter intended for the Corps News should reach the Editor not later than the 15th of each month for the following month's issue. Notices of Births, Marriages, and Deaths are inserted free of charge to subscribers and members of the Corps. All these communications should be written upon one side of the paper only; they should by preference be type-written, but, if not, all proper names should be written in capital letters (or printed) to avoid mistakes, and be addressed The Editor, "Journal of the Royal Army Medical Corps," 324, Adastral House, Victoria Embankment, E.C. 4.

Communications have been received from Lieutenant-Colonels G. J. S. Archer, C. H. L. Meyer, J. E. Hodgson; Major F. R. W. Walshe: Captains W. J. Tulloch, J. P. O'Malley, A. C. Lambert, A. Compton, F. A. Anderson; Lieutenant J. P. McGowan: R. Morison, Esq.

The following publications have been received:—

British: The Journal of Tropical Medicine and Hygiene, The Medical Press and Circular, Public Health, The Medical Journal of Australia, The Medical Journal of South Africa, The Hospital, The Army Service Corps Journal, Guy's Hospital Gazette, Tropical Diseases Bulletin, Journal of the United Service Institution of India, The Indian Medical Gazette, Transactions and Sixth Annual Report of the London Dermatological Society, Journal of the Royal United Service Institution; St. Bartholomew's Hospital Journal, The Royal Engineers' Journal, The Practitioner, The Journal of State Medicine, Proceedings of the Royal Society of Medicine, The Medical Review, The Quarterly Journal of Medicine.

Foreign: Bulletin of the Johns Hopkins Hospital, Colonies et Marine, Annali di Medicina Navale e Coloniale, La Caducée, Russian Medical Journal, Office International d'Hygiène publique, The Journal of Infectious Diseases, The American Journal of Syphilis, Archives Medicales Belges, Bulletin de l'Institut Pasteur, The Military Surgeon, Revista de la Sanidad Militar, Giornale di Medicina Militaire, L'Ospedale Maggiore, Archives de l'Institut Pasteur de Tunis, Bulletin de la Société de Pathologie exotique.

MANAGER'S NOTICES.

The JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is published monthly, six months constituting one volume, a volume commencing on 1st July and 1st January of each year.

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